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LECTURE II.[1]

(Delivered on Feb. 21st.)

MR. PRESIDENT AND GENTLEMEN,—Many of the symptoms of CO poisoning are similar to those which I have observed in shell shock with burial. It must not be supposed that in poisoning by illuminating gas or CO poisoning recovery is always complete, nor that the mental symptoms are always only of a transitory nature. It often takes months for the effects of the poisonous action of CO on the heart and nervous tissue to wear off, and in certain cases the damage is permanent. Some years ago I was called to see an officer who had been gassed in a submarine; he was mute, but while I was there talking to his mother, he suddenly spoke, saying, "That is my mother's voice"; his mind was gravely affected; his powers of recollection and recognition were almost lost. He was a good mathematician, but after the accident he could not do the simplest calculation—in fact, there was a profound dementia. Even two years later his mind was seriously affected, although he had a return of power of recollecting his later experiences.

The Crarae disaster in 1885 is of interest. A monster blast of gunpowder in a quarry attracted a number of persons from Glasgow. Twenty minutes after the explosion 100 onlookers collected in the quarry; 40 were rendered immediately unconscious, others fell down in a state of giddiness. Of the 40 seriously affected 6 died. Some of those who recovered developed convulsions on regaining consciousness; in others there was delirium, after which the patient became drowsy and slept. No secondary complications occurred, but in all there was great prostration, and a long period elapsed before they regained their strength. Haldane has found that the first decided symptoms occur when the blood is saturated with about 30 per cent. of CO; with every degree of saturation up to 50 per cent. the dangerous symptoms increase until loss of power and staggering prevent the individual escaping. Even after prolonged exposure to 0·1 per cent. of CO recovery is possible. With 0·2 per cent. loss of consciousness and loss of power occur, and in course of time death ensues. Exposure to 0·3 per cent. proves rapidly fatal. Inasmuch as this gas is inodorous, soldiers would be quite unaware of its presence, and lying unconscious in a dug-out or buried by sandbags in a trench which was being heavily shelled, they would stand a good chance of being poisoned by the gas without being in the least aware of it. A sapper told me that the enemy exploded a mine, and he and another out of a party of seven were the only soldiers who were taken out alive; none of the party were visibly injured, but he was unconscious for an hour or more. They were affected by the explosion and poisoned by the gas. He had been a miner and said the gas came through into the sap. While in the field hospital, "and after he had regained consciousness, he saw one of the bodies; it looked as if it were alive; the cheeks and lips were pink." He vomited, suffered with breathlessness and palpitation, and for some time with a splitting headache. He now is suffering from weakness and pronounced tremor of the lower extremities. His symptoms entirely agree with many of the cases of shell shock. An officer who, prior to heavy shelling of the trench in which he was, had been in good health was invalided home on account of headache, breathlessness on exertion, and palpitation. There was no organic lesion of the heart, and I could best account for the symptoms he complained of by CO poisoning. Another officer in the Engineers, a mine expert and of long service, told me that no doubt men who were buried in trenches or dug-outs would be liable to get CO poisoning before they were evacuated and rescued. The French military authorities have long been aware of the dangers of mine explosions; they speak of "l'enivrement de poudre."

SYMPTOMS OF CO POISONING.

The subject of CO poisoning, including the symptoms, is admirably discussed by Glaister and Logan in their standard text-book, "Gas Poisoning in Mining and other Industries." These authors point out that the commonest of all symptoms are headache, which may take the form of distension of the head without pain, ringing in the ears, interference with vision, which may become indistinct and blurred, hallucination of sight and even blindness, giddiness, especially on exertion, powerlessness, yawning and weariness, often vomiting, shivering and feeling of cold, palpitation of the heart, and a feeling of oppression in the chest. The action of CO is most marked upon the central nervous system. When men affected regain consciousness they appear dazed and stupid, and generally have no recollection of what happened. There is mental confusion, and they seem to have no power of concentration of thought, and they are unable to answer questions properly. Indeed, some of them look as if they were recovering from a drinking bout. The slightest anxiety or excitement will bring on a return of the symptoms complained of, such as tightness or oppression in the chest, palpitation and various pains and feelings of distress about the head, while beads of perspiration may appear on the forehead. Excitable and over-anxious members of rescue parties are the most susceptible to the effects of CO. Persons with a nervous predisposition therefore, as in the case of shell shock, are more susceptible to the effect on the nervous system. Emotional shock from terror may, as in the case of exposure to high explosives, play an important part in the production of these symptoms of functional neurosis. Leigh reports an accident where two men were gassed in a pit: one died, the post-mortem examination revealed cerebral hæmorrhage; the other, four months later, was still unfit for work. He suffered much mentally, was depressed, had lost his memory, suffered a great deal from insomnia, and ultimately fell into a condition of melancholia, was readily fatigued, and there was inability to concentrate his attention.

A very important derangement of the mind in CO poisoning is loss of memory. Knapp has recently recorded a case where besides a very intense retrograde amnesia there was also loss of recognition. This loss of recollection is not only of

[1] Lecture I. was published in THE LANCET of Feb. 12th, p. 331.

what happened at the time of the accident and for a certain time subsequently, but it is also retrograde—in fact, a whole period of time may be erased from the mind. Bloch has recorded a case where loss of memory without any other disorder was a prominent symptom. Glaister and Logan also call attention to disturbances of speech. In some survivors speech is affected. The power of speech may be lost for some time or it may come back after many days. In some there is difficulty in uttering the words, and as the patient's mind is generally confused and his reaction slow a curious impression is given to the observer of great effort being required to speak by the patient. The patient often repeats himself, iterating and reiterating words and phrases. This affection of speech generally only lasts for a few days, but in rarer cases it may be months and years before speech returns to normal. When this happens there are generally other mental symptoms. Tremors frequently occur. These symptoms so accord with those functional disorders of the central nervous system which have so frequently been found to occur in shell shock with burial that one naturally thinks it possible that while lying unconscious at the bottom of a trench or dug-out sufficient CO is inspired to cause these severe effects on the mind which some of these cases exhibit. In some cases there are marked tremors, and when intentional and accompanied by other signs a condition of disseminated sclerosis may be considered. (Figs. 1, 2, and 3.) A case with multiple punctate hæmorrhages that was not fatal might easily occasion islets of sclerosis, and this may be the explanation of a case narrated by Dr. Wilfred Harris.

HISTOLOGICAL CHANGES IN THE BRAIN IN CO POISONING, SHELL SHOCK, AND SPINAL CONCUSSION.

I will now describe briefly the changes which I have found occurring in the brain in poisoning by CO, for they seem to be identical with those found in a case of the brain of a man admitted unconscious with a history of having been buried by a shell blowing in the parapet. The history does not relate how soon after burial he was excavated.

Two of the cases which I have investigated came from carbonyl of nickel works, and, as you will observe, there are multiple punctate hæmorrhages throughout the white matter, especially observable in the corpus callosum, the internal capsule, cerebral peduncles, and centrum ovale. (*Vide* Figs. 1, 2, and 3.) CO is used in the manufacture of carbonyl of nickel, and I have no doubt that it was inhalation of this gas which caused the deaths. I had also the opportunity of examining the brain of a woman who killed her two children and committed suicide by taking off the gas burner and allowing the gas to escape into the room where she was with her children. The children were found dead in the room. She died four days after admission to Charing Cross Hospital. Her blood was examined spectroscopically and by Haldane's method. (Figs. 4 and 6.) I found in this case the same multiple punctate hæmorrhages throughout the same situations, especially in the white matter of the brain. Examination of the medulla by Nissl method showed exhaustion of the Nissl substance in the cells. (Fig. 6.) A full account is given by Logan and Glaister, with illustrations taken from the original communication.[2] I want you to take note of these photographs and photomicrographs, for I think you will agree with me that they closely correspond to those observed in the brain (Fig. 7) which I am about to describe, and of which I will show photographs and photomicrographs.

CASE 1.—*Fatal case of shell shock with burial.*—Specimen received from Captain W. E. M. Armstrong, R.A.M.C., No. 7 Mobile Laboratory, B.E.F. Sent on from No. 1 Mobile Laboratory. No. 8 on Captain Armstrong's list. Brain of man (Figs. 7 and 8) admitted unconscious with history of having been buried by shell blowing in parapet. Remained stertorous for two days and died. *Post mortem:* There is no wound of any kind on his body or head, and no visceral lesion. His ankle on one side was badly "sprained," but there were no fractures. The skull was unfractured, and no fracture of the base could be found. Brain shows multiple capillary hæmorrhage and (some slight) subpial extravasation. No other particulars.

Histological examination of the brain.—Throughout the white matter of the centrum ovale, and especially in the corpus callosum internal capsule (Figs. 7, 8A, and 8B) and cerebral peduncles, are multiple punctate hæmorrhages. They also occur in the subcortical white matter and in the basal ganglia. In many places these hæmorrhages have coalesced into large areas and in the parieto-occipital region there is a diffuse purple staining of the white matter around the hæmorrhagic area. Microscopic examination shows isolated capillary hæmorrhages in the grey matter; in the medulla there are only congested vessels, but no hæmorrhages. This appearance to the naked eye corresponds to that which I have described in CO poisoning. Sections of the brain were cut after hardening and embedding in celloidin and stained with hæmatoxylin eosin, van Gieson, and by Nissl method. The same microscopic appearances were observed as those seen in coal gas (CO) poisoning, only the hæmorrhages were more extensive. As in the case of coal gas poisoning where the patient lived four days, instead of 48 hours, as in this case, the cells of the medulla (Fig. 12) showed a marked chromatolysis with swollen clear eccentric nucleus, similar to the change observed in experimental anæmia of animals. It is most marked in the cells of the vagus nucleus, but more or less general throughout. In the cortex many of the Betz cells show a very marked chromatolysis, swelling of the cell and eccentric nucleus, while others in the immediate neighbourhood may possess a fairly normal amount of basophile Nissl granules. But all stages may be met with. These photomicrographs show the above-mentioned changes which correspond with those due to deoxygenation of the blood by CO poisoning or by experimental anæmia by ligation of all four arteries. As I can find the most extensive hæmorrhages, but no evidence of sudden death and swelling up of the axons as in the case of spinal concussion, I have come to the conclusion that it is possible, if not probable, this man was rendered unconscious by shell shock, and that while buried he was poisoned with gas. I am of opinion that the evidence is strong enough to warrant clinical attention being given to this matter, and the blood of persons who are suffering from so-called shell shock resulting in unconsciousness, especially where there has been burial, should be tested for CO poisoning.

The following notes were received through Major C. S. Myers of a case of spinal concussion without visible external injury in which excavation was effected within five minutes of burial:—

CASE 2. *Spinal concussion from burial; no gross injury, no fracture and no dislocation of vertebræ. Macroscopic hæmorrhage in cervical cord; characteristic microscopic changes. Paralysis of both arms, legs, and intercostals, anæsthesia; consciousness retained until death.* — Lance-Corporal A——, admitted to No. 17 Casualty Clearing Station on Sept. 11th, 1915, suffering from paralysis. Captain W. J. Adie, R.A.M.C. (S.R.), writes: "On the morning of the 10th inst., during a heavy bombardment of one of the trenches, this man was buried in his dug-out under timber, sandbags, and earth. He was excavated within five minutes and it was noted that he had lost the use of his arms and legs. He was conscious and rational. He did not complain of pain. I was not called to see the man as he had no wound and there were many serious cases needing attention. In the morning he arrived at the

[2] Mott: Carbon Monoxide and Nickel Carbonyl Poisoning, Archives of Neurology, vol. iii., 1907, p. 247, et seq.

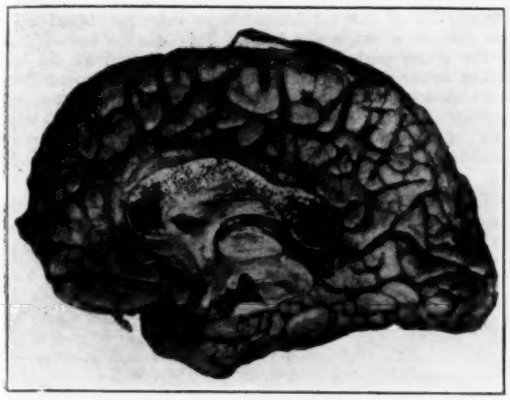

FIG. 1.—The right hemisphere of a worker at the nickel carbonyl manufactory, probably CO poisoning. Note the punctiform hæmorrhages in the corpus callosum which have coalesced into hæmorrhagic masses at each extremity.

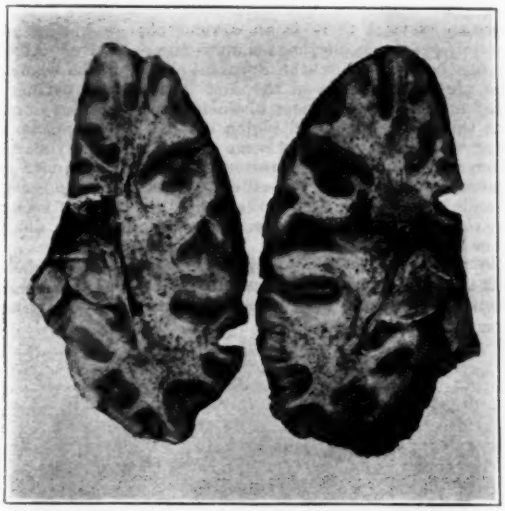

FIG. 2.—Vertical sections through the hemispheres showing coalescence of the punctiform hæmorrhages in the corpus callosum and internal capsule and throughout the whole of the white matter punctiform hæmorrhages.

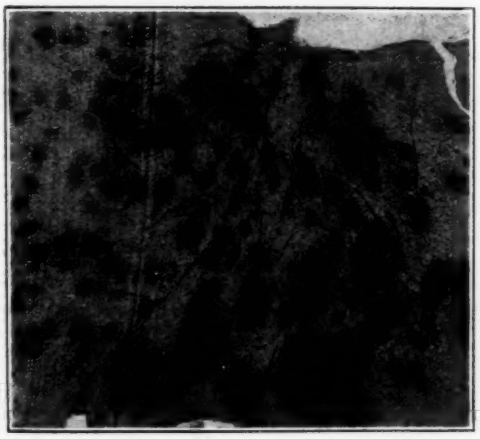

FIG. 3.—Photomicrograph of a section of the corpus callosum showing the hæmorrhages. (Magnification 10 diameters.)

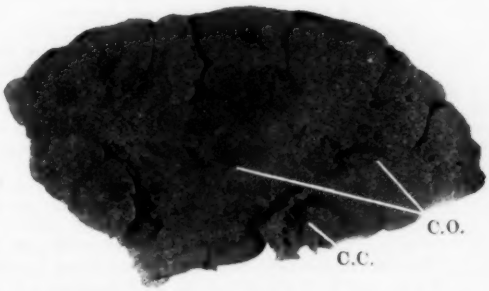

FIG. 4.—Vertical section of a cerebral hemisphere of a woman who committed suicide by inhalation of illuminating gas. Death in four days. Spectrum of blood showed CO poisoning. There are punctiform hæmorrhages throughout the white matter which have coalesced in some situations, notably the corpus callosum (C.C.) and centrum ovale (C.O.). For the sake of space this figure is placed horizontally.

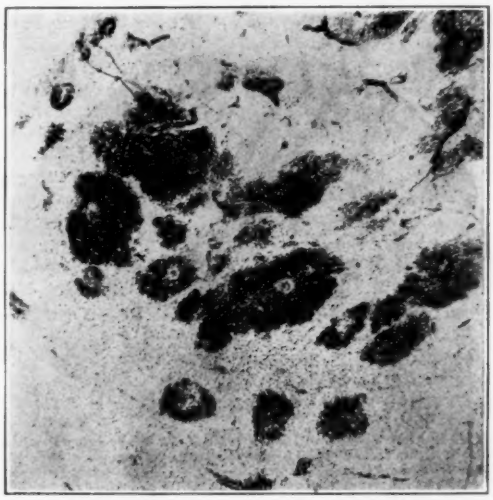

FIG. 5.—Photomicrograph of section of corpus callosum from case of shell shock showing the capillary punctate hæmorrhages. In several a small white area is seen of brain tissue in the centre of which is a small artery or vein. (Magnification 20 diameters.)

FIG. 6.—Section of medulla oblongata from case of gas poisoning, stained by Nissl method, showing the swollen cells of the nucleus ambiguus. Observe the enlarged, clear, eccentric nucleus; the surrounding cytoplasm shows an absence of Nissl granules. In not a single cell is the nucleus seen in the centre as it should be. (Magnification 450.)

dressing station just as the ambulance was leaving and was put straight in. I regret that I did not see him." The patient was sent down on the early morning of the 11th to the 18th Field Ambulance and told the medical officer that he had "shell shock." His pulse was then 40 and temperature 97° F. He complained of pains in his head and back. On the same morning later he was admitted to the casualty clearing station, where Lieutenant Dew observed rigidity of his legs and noticed that he was in a state of "cerebral irritability," calling out "Let me alone." I (Captain Adie) was asked to see him on that day, but he could not be found by the sergeant-major, so having several other cases to see I did not see him until the next day.

On the morning of Sept. 12th he was seen at 11 A.M. by Captain Dennis and Captain Stokes. He was lying flat, his abdomen was rigid; he showed total flaccid palsy of both legs and arms. A feeble extensor response (easily fatigable) was obtained from the right sole, no response from the left. The cremasteric reflex was absent on the right side; was present, but easily fatigable, on the left side. The abdominal and patellar reflexes were absent. The sphincters were not paralysed. His breathing was shallow and laboured. The ribs were motionless. Sensation was completely absent on the limbs and on the trunk up to apparently the second cervical level, but his mental condition was too bad for

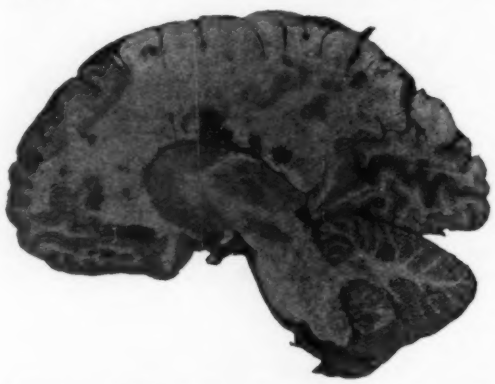

FIG. 7.—Section through the whole brain, Case 1, shell shock without visible injury, one inch external to the mesial surface. Punctiform hæmorrhages are seen in the white matter which have coalesced in the corpus callosum, corona radiata, and in the white matter of the hemisphere generally.

the results to be very reliable. Heat and cold were indistinguishable.

At 12.30 P.M. I saw the patient. The orderly reported to me that the patient was continually asking to have his position shifted. I saw him propped up, when his abdomen was flaccid. He was obviously near death, and it was difficult to get much from him. He protruded his tongue normally at request. He complained of feeling sick and of being unable to get his breath; "I am tied up," he said. Speech normal. Total intercostal palsy. Pulse full, slow, 54. Complete flaccid palsy and anæsthesia of all limbs. Plantar response: left leg, normal; right leg, faint flexion of proximal phalanges. No difficulty in swallowing. No incontinence or retention of urine or fæces. Unable to get any history from him. He died at 1.30 P.M.

Post-mortem examination at 2 15 P.M. by Captain Stokes. Slight but not definite mobility of the fourth cervical vertebra. No dislocation or fracture of vertebræ found. No external wound. A good deal of intravertebral hæmorrhage while getting out the cord (? normal bleeding from venous plexus). No clot in the vertebral canal. Some hæmorrhage within the upper part of theca, but this probably got in from the cut end. Hæmorrhages within cord in mid-cervical region and possibly in upper dorsal region. Cord preserved in 5 per cent. formol.

Description of cord by Dr. Mott (Sept. 17th, 1915).—There are visible hæmorrhages in upper cervical region, extending about 1 inch on external surface of dura mater. On reflecting dura a subpial hæmorrhage can be seen ½ inch in length, ¼ inch in breadth over posterior surface of the cervical cord beneath the pia-arachnoid. The central canal at the level of the third cervical and about the level of the middle of subpial hæmorrhage contains blood about the size of a large pin head. This can be traced down to the upper part of the fourth cervical, and at the level of the lower part of the fourth cervical segment there is an obvious extension of the hæmorrhage into the right anterior horn. At the level of the fifth and upper part of the sixth cervical the hæmorrhage apparently extends throughout the whole of the grey matter. At the

FIG. 8A.—Vertical section through the left hemisphere in the frontal region showing coalescence of hæmorrhages in the corpus callosum, internal capsule, and lenticular nucleus.

seventh cervical there is an obvious change in the grey matter, but the hæmorrhage is much less extensive. At the eighth cervical there is an apparent change in the whole of the grey matter, also in the first dorsal. The outline of grey matter becomes more distinct about the third dorsal, but throughout the dorsal region the naked-eye appearance suggests the probability of some change in the grey matter. Even in the lumbo-sacral region the grey matter does not appear quite normal in its outline. Subsequent microscopic examination of sections showed that the changes seen in the outline of the grey matter above described was due to some congestive œdema.

Histological examination of the spinal cord.—The spinal cord was hardened in formol and cut after embedding in celloidin. Sections were cut and stained by van Gieson, Weigert

FIG. 8B.—Vertical section through hemisphere, Case 1, showing a wedge shaped area of coalesced hæmorrhages upon the under surface of the anterior part of the occipital lobe. This is the only region where the hæmorrhages had coalesced so as to form in the grey matter an area visible to the naked eye, but throughout the cortex, as in the case of CO poisoning, there are capillary hæmorrhages; at this situation the hæmorrhage has ruptured the grey matter and produced a subpial extravasation. The microscopic appearances of the hæmorrhages in no way differ from those seen in Figs. 3 and 5.

Pal, and Nissl methods. The appearances presented correspond with those described by Colonel Gordon Holmes in gunshot injury of the spine without penetration of the dura mater but causing concussion of the spinal cord. (*Vide* Figs. 13 14, 15, 16, and 17, with descriptive text). It is presumed, as there was no visible sign of injury, that the man was struck on the neck by a sandbag, for he was partially buried. It is difficult to account for the limited area of the lesion by the blow of such a bulky object as a sandbag, and there was no evidence of dislocation of the vertebræ. The fact that the subpial hæmorrhage was over the posterior column, and the damage affected especially the posterior column and the grey matter, suggests that a pressure wave of the cerebro-spinal fluid was set up by the concussion, and the grey and white matter lying between the fluid in the central canal and the subarachnoid received the full force of the shock.

Had it been a segment higher, instant death from complete destruction of the phrenic nucleus would have occurred. As it is, the microscopic examination shows that a partial destruction of the "nucleus diaphragmaticus" took place. (Fig. 18.)

Dr. Sano, who has made a special study of the origin of the phrenic nucleus (diaphragmaticus),

FIG. 9.—Photomicrograph of a Betz cell showing swelling of the cell; disappearance of the Nissl bodies. The nucleus is clear, large, and eccentric; in the immediate neighbourhood are cells in which this change has not occurred. It is probable that hæmorrhage has ruptured the axon of this particular cell. (Magnification 800.)

has been kind enough to look at these sections and indicate exactly the group from which the nerve arises; it is the median group of the anterior horn. These cells are entirely destroyed in the fourth and fifth segment, but are present in the third.

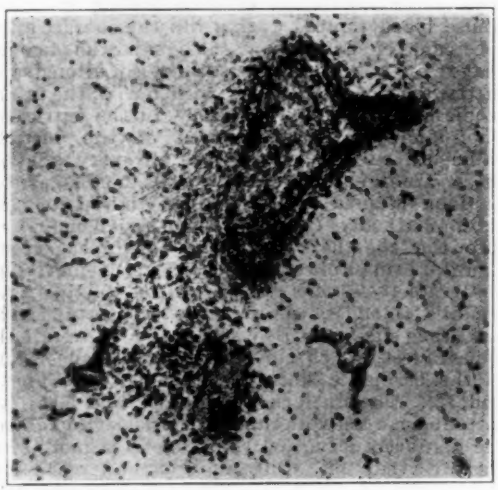

FIG. 10.—Photomicrograph of section of corpus callosum, showing inflammatory change around a small vein, a branch of which has ruptured. The deeply stained cells that are seen in the perivascular sheath are leucocytes. (Magnification 200.)

They show, however, as compared with the other ganglion cells in the anterior horn at this level some chromatolysis, as if under the stress of increased activity the basophile kinetoplasm had undergone some disintegration without corresponding reintegration. The posterior column at the seat of the concussion presents a diffuse sieve-like vacuolation of the myelin fibres, such as has been described by Gordon Holmes. One sees also the enormously swollen axis-cylinders. This also is seen well in longitudinal sections (*vide* photomicrographs). The shock may have been so great as to have killed the axoplasm; for, as Leonard Hill in a letter to me says: "A water pressure of between 300 and 400 atmospheres kills all protoplasm (excepting deep-sea fishes). Water

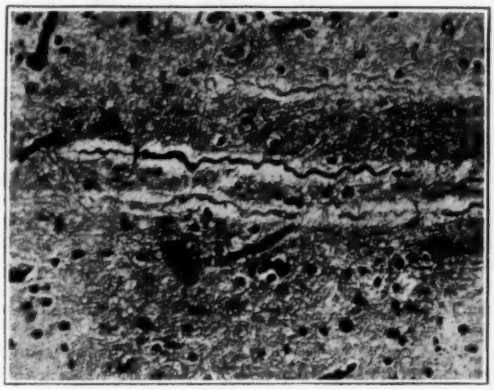

FIG. 11.—Myelinated projection fibres in the motor cortex. Three twisted axis-cylinders are seen; they are not swollen. (Magnification 300.)

enters into the muscle and swells it and turns it opaque. There are curious fractures produced in the muscle fibres. The myelin of nerve fibres is broken up by the water entering into these." Then he goes on to say: "In the case of a high-velocity

FIG. 12.—Section of medulla oblongata from case of shell shock with burial, stained by Nissl method, showing the swollen cells of the nucleus ambiguus. Observe the enlarged, clear, eccentric nucleus; the surrounding cytoplasm shows an absence of Nissl granules. In not a single cell is the nucleus seen in the centre as it should be. (Magnification 450.)

bullet striking the spine it seems possible that the cerebro-spinal fluid beneath the struck part may be instantly compressed and act as a solid body transmitting the blow to the cord. There cannot be time for the fluid to be displaced. There is, anyway,

a water-pressure limit beyond which protoplasmic activity is destroyed, and I imagine bullets must produce this pressure, but I very much doubt whether air waves produced by shell-bursts can reach to such pressures as 300–400 atmospheres." It is quite possible that a sandbag hurled against the neck could produce this effect without producing visible injury. This sieve-like character of the white matter and the large swollen axis-cylinders are only found in the posterior column from the fourth to the seventh segment inclusive. There are hæmorrhages in the white matter of the posterior column as low as the seventh cervical. Below this segment no hæmorrhages are seen in the white matter, but congestion and small capillary hæmorrhages are found throughout the grey matter of the spinal cord. Since only about 48 hours elapsed between the concussion and death, there was no time for degenerative appearances of the white matter to occur; there was apparently a sudden destruction of a portion of the axons in the posterior column. No physical or chemical changes have occurred in their continuity above and below the seat of concussion, which certainly would be shown in the long fibres of Goll's column, where a large number of these greatly swollen axons and vacuolated myelin sheaths are seen. Although there are hæmorrhages at the seat of the lesion in the posterior column, the greatest amount of hæmorrhage is in the more vascular grey matter and, as the photomicrographs show, the destructive disintegration is very marked at the level of the fourth and fifth cervical (*vide* Figs. 13 and 14); it is also seen to a less degree in the sixth and seventh. Shock, no doubt, interfered with the autonomic activity of the muscles of respiration below the lesion; it is remarkable that it did not produce a shock effect on the bulbo-spinal nuclei above. This shows how well protected they are from shock, also that a transverse lesion of the cord produces a shock effect down the efferent projection fibres and not up the afferents. It is noteworthy that this undoubted case of spinal concussion without visible injury accords in the histological changes with those described by Gordon Holmes. The blood contained in the area of hæmorrhage in the posterior column would soon be absorbed and give rise to the cavitation observed by Holmes in this region.

Now, contrasting this case of undoubted spinal concussion, in which the man was excavated within five minutes of burial and in which there was no loss of consciousness, with Case 1, in which there was complete loss of consciousness, we find that in the latter there are multiple punctate hæmorrhages of varying size in the white matter and the basal ganglia especially, and this condition we might explain by a blow of a sandbag on the head. The cause of the hæmorrhages being found especially in the white matter, on the supposition of the lesions being due to concussion might be attributed to the fact that the ventricles are filled with the incompressible cerebro-spinal fluid to which the violent shock is transmitted.

Against this view is the fact that a careful search does not show the swollen axis-cylinders, so characteristic a feature in the case of undoubted localised spinal concussion. The axis-cylinders arising from the large Betz cells in Case 1 are of the normal size; they are somewhat coiled up, but this is due to unequal shrinkage of tissue in the process of hardening and fixation (*vide* photomicrograph, Fig. 11). Had there been cerebral concussion in this case of a similar nature to that in the case of spinal concussion, one would have expected to find swelling of the axons of the fibres of the internal capsule and corpus callosum, but a careful search revealed no such swollen axon fibres, nor was there any vacuolation.

The marked chromatolysis of the cells of the medulla, with eccentric position of the nucleus, have appearances corresponding with those found in a case of coal-gas poisoning, and they correspond to the appearances presented by cells deprived of oxygen by experimental anæmia as a result of ligation of arteries. The chromatolysis of certain groups of cells of the medulla is more marked than the chromatolysis of the cells of the cerebrum, where the hæmorrhages are more numerous and extensive. It may therefore be concluded that the cells of the vegetative centres—e.g., respiratory and cardiac centres—are more exhausted. The store of basophile substance (representing neuro-potential) has been in great measure exhausted.

I have referred especially to CO poisoning, but there may also be poisoning by oxides of nitrogen. Nitric oxide would, however, act more as an irritant poison on the respiratory passages, setting up pneumonia. It has been noticed also that pneumonia is very liable to supervene on CO poisoning. The woman admitted to Charing Cross Hospital comatose and suffering from carbon monoxide poisoning died of pneumonia four days after admission, never having regained consciousness.

As it might be thought that the cases of nickel carbonyl poisoning are not really a fair comparison for carbon monoxide poisoning, I have compared the appearances of the cells of the cortex and medulla with those of the woman who died four days after inhalation of illuminating gas, and whose blood showed during life the characteristic spectrum of CO. Now, although the hæmorrhages in the cerebrum are not so extensive as in the case of shell shock with burial, the microscopic appearances are similar in the two cases. The microscopic appearances of the medulla oblongata in the two cases are very similar: there are no gross naked-eye hæmorrhages, but sections stained and examined microscopically show markedly congested vessels, hæmorrhage into the sheaths, and subpial hæmorrhages, and there are small microscopic capillary hæmorrhages observable. All the cells, large and small, in the medulla oblongata of both cases, the gas poisoning and the shell shock with burial, show similar appearances of chromatolysis and disappearance of the basophile staining substance (*vide* Figs. 6 and 12). The nucleus is enlarged and clear, the intranuclear network and the nuclear membrane are distinctly seen, and the nucleus is more often eccentric than not. Only a few of the larger multipolar cells of the somatic nuclei show any Nissl granules, and then they are less numerous than in the normal cells, and there is often a tendency for the chromophile substance to exist in the form of irregular-shaped granules or a fine dust. If it can be assumed that the amount of this stainable substance which forms the Nissl granules is an indication of the amount of kinetoplasm in the neuron, then in both cases there is a universal disappearance of this substance both in known CO poisoning and the case of shell shock with burial. The cause of this change in the gas poisoning is due to

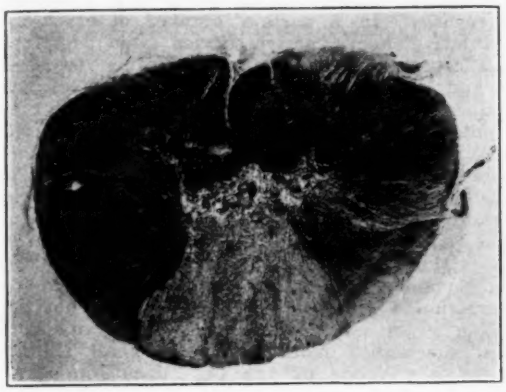

FIG. 13.—Section of the fifth cervical segment of spinal cord of Case 2, spinal concussion without evidence of external injury. Observe the appearances of the grey matter and the posterior column, and the antero-lateral column of one side as compared with Figs. 14 and 15. This is at the seat of concussion. (In Figs. 13, 14, and 15 Weigert-Pal staining was employed.)

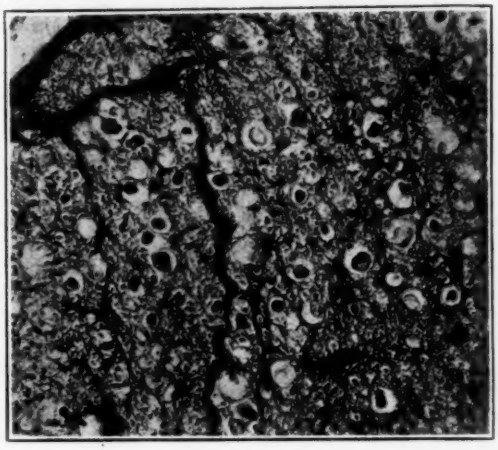

FIG. 16.—Section of periphery of posterior column at the level of the fifth cervical segment. Vacuolation of myelin sheaths and many swollen axons are seen. (Magnification 300.) Van Gieson staining.

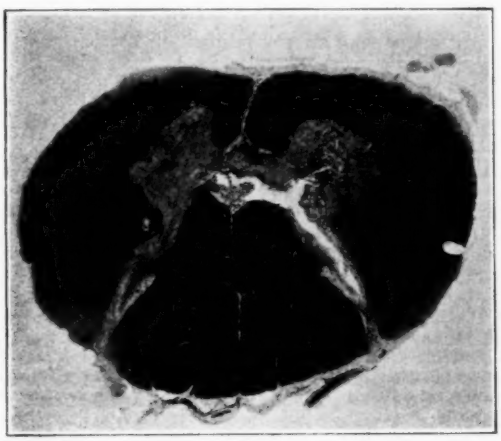

FIG. 14.—Section of the fourth cervical segment—observe the cavitation of the grey matter starting from the central canal and extending into the anterior horn and down the posterior horn of one side. It is only in these two fourth and fifth segments that gross macroscopic changes can be observed.

FIG. 17.—The above seen in longitudinal section; the dark stained swollen axons are seen. (Magnification 200.)

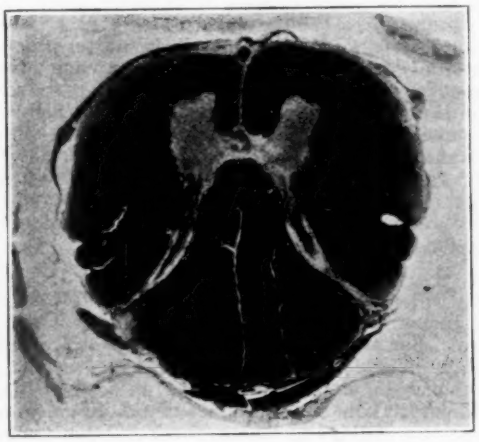

FIG. 15.—Section of the third cervical segment. No gross macroscopic changes are observable.

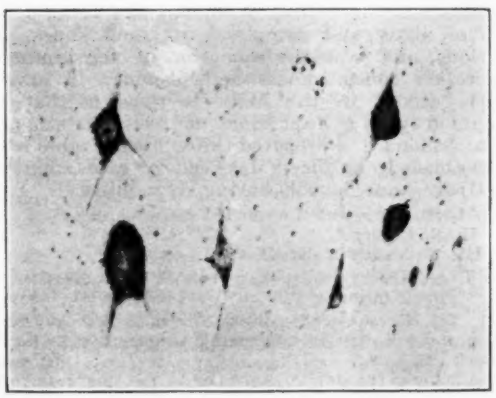

FIG. 18.—Section of third cervical segment of spinal cord case of concussion, stained by Nissl method, showing the median group of anterior horn cells corresponding to the nucleus diaphragmaticus, and they show a certain amount of perinuclear chromatolysis, but all the cells exhibit the Nissl granules. Even at the seat of concussion, the fourth segment, an external group of cells remain showing Nissl granules. Concussion therefore does not destroy the Nissl granules. Probably the cells of the nucleus diaphragmaticus show a certain amount of chromatolysis because they were continually discharging impulses along the phrenic nerves, and the few cells that were left of the nucleus had therefore much more work to do. (Magnification 300.)

vascular stasis and lack of oxygen, and it is a reasonable hypothesis to suppose that the similar change in the medulla in the case of shell shock with burial and possible exposure to CO may be due to vascular stasis and lack of oxygen due to inhalation of sufficient CO to produce fatal effects before excavation could be effected. At any rate, this case suggests the desirability of examining the blood during life for CO in severe cases of shell shock without visible injury and where burial has occurred, and especially if some time has elapsed before excavation. This is all the more desirable seeing that the possibility of CO being produced in sufficient quantities by the imperfect detonation of high-explosive shells to cause poisonous effects is admitted by those competent to judge.

MENTAL AND BODILY CONDITION OF THE INDIVIDUAL AT THE TIME OF RECEIVING THE SHOCK.

Having thus discussed the various causes which may act upon the central nervous system as the direct outcome of the detonation of high explosives, I will pass on to a consideration of the mental and bodily condition of the patient at the time of receiving the shock of the explosion. Before, however, considering this, the personal factor, I will recapitulate the possible effects of the detonation of high explosives on the nervous system in cases where there is no visible external injury. They are: 1. Commotion from the aerial compression. 2. Concussion with or without burial. 3. Decompression with embolism, by bubbles of N and CO_2. 4. Inspiration of CO during the aerial compression. 5. Prolonged inhalation of noxious gases—e.g., CO—while lying unconscious or partially buried.

The mental and bodily condition of the individual at the time of the shock may be classified as follows:—1. Inborn: (*a*) A timorous disposition and an anxious temperament; (*b*) a neuropathic or psychopathic inheritance. 2. Acquired: (*a*) A *locus minoris resistentiæ* in the central nervous system in consequence of alcoholism, syphilis, or previous head injury; (*b*) a lowered neuropotential, the result of a post-febrile neurasthenia; (*c*) nervous exhaustion the result of mental stress, anxiety, insomnia, and terrifying dreams; (*d*) bodily exhaustion from fatigue, cold, wet, and hunger.

The signs and symptoms of shell shock are various, and with the exception of the profound effect on consciousness and memory in severe cases accord in the main to those of the two common types of functional neurosis, hysteria and neurasthenia. I prepared the following table from notes made by Dr. Cicely May Peake on cases admitted to Grove Lane Schools during six months:—

I. History reported on in 156 cases (shock).
II. No history ,, ,, ,, 80 ,, ,,
III. No history of shock in 40 ,, ,,

I. A. History predisposing to shock in 111 cases.
B. No history ,, ,, ,, ,, 45 ,,

A. (*a*) Nervous predisposition (previous nervous breakdown, timid disposition, neuropathic temperament as family history, &c.) ... ... 52 cases.
(*b*) Epilepsy (pre-war 20, since war 5). Of the latter, one had head injury and two bits of bone removed in 1904, and one developed fits after shrapnel wound of head (frontal) trephined during war ... ... 25 cases.
(*c*) Shock or accident (pre war) ... ... 11 ,,
Traumatic (pre-war) ... ... 9 ,,
(*d*) History of insanity (patient 2, family 7) ... 9 ,,
(*e*) Mental defectives ... ... 5 ,,

It will be observed that a large majority of the cases of so-called shell shock admitted with functional neurosis in some form or other occurred in individuals who either had a nervous temperament or were the subjects of an acquired or inherited neuropathy. In a certain number of cases the cumulative effect of active service, often combined with repeated and prolonged exposure to shell fire and projectiles containing high explosives, had produced a neurasthenic or hysteric condition in a potentially sound individual. Some of the worst cases have occurred in soldiers and non-commissioned officers of years' standing—men of excellent physique who have led active lives without any evidence of a nervous breakdown; some, indeed, have fought in the South African War, and in this campaign had been in many battles and engagements without previously exhibiting any neurasthenic symptoms, but at last the nervous system gives way. Such men have not, as a rule, succumbed from a single "shell shock," unless it was one of the big "Jack Johnsons," but only after a third or fourth, and when they have been run down with the stress and anxiety of continuous apprehension and dread of the enemy surprising them. On the other hand, there are "the more or less rapid breakdowns" who give usually a history of either previous head injury, or of a nervous breakdown in ordinary life, or after some special stress indicative of a nervous temperament or a neuropathic disposition. Among the large number of officers I have seen sent back on account of neurasthenia, a considerable number associated with shell shock, I have not observed a single case of functional paralysis or mutism.

Although the shock of shell fire cannot introduce the spirochætes into the brain, yet the commotion caused by the explosive and the depressing conditions of trench warfare might lower the resistance and enable the latent spirochætes to take on active development. The following case was of interest:—

A young man, aged 26, with unequal pupils, sluggish reaction to light and strangeness of conduct. By the fact that he had Hutchinsonian teeth I thought that he might be suffering from juvenile general paralysis of the insane. An examination of the cerebro-spinal fluid gave a Wassermann reaction and lymphocytosis, which confirmed the diagnosis.

Cases which were said to have developed epilepsy as a result of shell shock were, generally speaking, individuals whom it might fairly be assumed were either epileptics or potential epileptics prior to the shock. It was judged that they were epileptics or potential epileptics by the fact that they had attacks of fainting, petit mal, or dizziness prior to the war. Some gave a history of automatic wandering, but it is quite possible that the dazed condition which may ensue from exposure to explosive forces may lead to such conditions, for which they could not be held responsible or be treated as deserters. Much depends upon whether they know the quality of their acts at the time. It will be observed that out of 25 cases of epilepsy there were only 5 in which there was not some pre-war evidence, and of these 2 might be associated with head wounds.

EPILEPSY.

My colleague at the 4th London General Hospital, Dr. James Collier, in a recent discussion at the Royal Society of Medicine on Shell Shock without Visible Injury, stated: "I do not think psychopathic and neuropathic antecedents are of importance as determinants of functional manifestations following shell shock. What seems more important are the proximity of the explosion and the violence of the sensory effect, provided consciousness be retained." He then went on to

say, "Major Mott has referred to epilepsy occurring *only* in those who have previously had fits or in whom there is a family history of the disease." What I did say was: "Cases which were said to have developed true epilepsy as a result of shell shock, the history showed were *nearly always* individuals who had previously suffered with true epilepsy or an anomalous form of it, or that they were potential epileptics prior to the shock might be assumed from the fact that they had suffered with slight faints or automatisms, or that there was a history of epilepsy or insanity in the family." Dr. Collier rightly and justly points out the importance of this from the point of view of allotting compensation. I therefore have carefully summarised the pre-war histories of all the cases of epilepsy under my care who had been returned from the front since June. I am enabled, from the very careful notes taken for me by Dr. Cicely May Peake, who for six months has devoted her whole time to investigating these functional cases for the Medical Research Committee, from whom she received a grant, to show that my statement was based upon facts.

I have been studying for 10 years the subject of hereditary predisposition of epilepsy and insanity, and the several hundred pedigrees which I possess make me certain that of all nervous diseases epilepsy is the one in which an inborn tendency is shown more than in any other nervous affection. I do not wish to imply that shock may not be a potent, exciting, or aggravating cause, but I am of opinion that "shell shock" is not *per se* the cause of epilepsy in the majority of cases. This question is, as Dr. Collier states, of great importance in deciding whether a pension should be granted. Now epileptics are not admitted to the army, if it be known, and they are required to state that they have not suffered from epilepsy. Many do not know, but some wilfully conceal the fact that they have previously had fits, or they may think they have been cured. Again, a man may know that if he can claim that he is an epileptic his services will be no longer required, and he can state that the shell shock was the cause and claim a pension for being incapacitated by active service. This question of epilepsy being caused by shell shock is one which deserves very careful investigation and attention, and for this reason I have given here brief details of all the cases of epilepsy under my care the subjects of which have been to the front. The facts may stimulate others to make careful inquiries before assuming that shell shock was in a particular case necessarily the cause *per se* of epilepsy.

A Brief Summary of Pre-war History in 25 Cases of Epilepsy.

CASE 1.—Private ——. Mother had fits five years, only a few. Brother had few convulsions at 5 years of age.

CASE 2.—Private ——. Had fits at home and his medical attendant who saw one said they were epileptic. He did not bite his tongue, but had a handkerchief in his mouth when he came to. His father had fainting fits once a week regularly on Sunday afternoons.

CASE 3.—Private ——. Mother, now dead, had fits; does not remember any other relative with fits. Has never gone sick, and would not have done so now only "the doctors came on the scene when he was taken."

CASE 4.—Private ——. Had fits before, when he went to school. Had seven or eight, the last at 13 years. Mother had fits; none since she was 30. Two sisters had fits; one has them still at 31; she bites her tongue.

CASE 5.—Private ——. Was operated on for stone in kidney in 1912 (twice) and had five "hysterical fits" between the two operations.

CASE 6.—Private ——. Had fits as a child, used to pass urine in them, and often hurt himself. Had no fits for 18 months before he joined the army.

CASE 7.—Private ——. He had little schooling because from the age of 6 or 7 he suffered from seizures. He lost consciousness, fell down (hurt his head occasionally). Never bit tongue or passed urine while in the fits. He had no more after 12. When he joined the army he told the medical man. He had seven more seizures at Aldershot. Father and one sister had "seizures."

CASE 8.—Private ——. Had fits every other week before injury and five in a week afterwards. Had them from 9 to 10 years; sister had fits also and bit tongue.

CASE 9.—Lance-Corporal ——. Had a similar fit when aged 18. He was picking up a jug of water to wash with, dropped it, and lost consciousness. Did not bite tongue or pass urine during the seizures. One uncle very nervous.

CASE 10.—Private ——. Began to have fits at 18. Always had blood in his mouth when in a fit, and had often passed urine when he came to. Sometimes he is free for three or four months at a time. Scars on tongue.

CASE 11.—Lance-Corporal ——. Seven years ago had an epileptic fit. Before rejoining was in Garrison Artillery; left it because he failed in an examination. Says he was unconscious when in a fit; saw everything going round and breathed fast. Did not bite tongue or pass urine.

CASE 12.—Private ——. Suffered from epileptic fits as a child, but never had one since he was 6 years of age.

CASE 13.—Private ——. Had a few fits in civil life, about a dozen; began when he was 16. One brother had nervous breakdown.

CASE 14.—Private ——. Had a fit before enlisting. Says he would have denied it if any question had been asked.

CASE 15.—Private ——. He had been picked up unconscious on the Palace Pier, and knew nothing till he was in hospital next morning. In the trenches and while in training he sometimes found he had lost himself for a few minutes. These fits lasted about 10 minutes.

CASE 16.—Private ——. In England after long marches he four times had a fit; bit tongue, but did not pass urine. Had two or three fits in civil life over a year ago. None before that. Was always frightened of motor-cars.

CASE 17.—Private ——. Had fits (about 20 altogether) from 7 to 17 years of age. These came on in hot weather. He felt dizzy beforehand, then fell, struggled, was unconscious about 15 minutes, and had headache afterwards. Always fell, never hurt himself, never bit tongue or passed urine. Thinks his mother used to have fits.

CASE 18.—Sergeant ——. Had one fit in South Africa.

CASE 19.—Private ——. Has had three fits in civil life between ages of 19 and 21. Bit tongue and passed urine in all three. One sister has had several fits.

CASE 20.—Private ——. Had fits as a child.

CASE 21.—Private ——. Has scar on forehead—depression of skull the result of a blow from a swing-boat which fractured his skull. Has had several fits since enlistment.

CASE 22.—Rifleman ——. No family history of fits; no previous history of epilepsy.

CASE 23.—This patient began to have fits after getting his head compressed between two coal tubs in the pits. After this accident he was ill for a month. A sister had epileptic fits.

CASE 24.—Gunner —— No family history of fits.

CASE 25.—Private ——. No family history of fits. Linear scars of operation over frontal region with trephine hole which has shelving edges.

It will be observed that out of 156 cases in which a previous history is reported in the notes, 52 gave a history of either a previous nervous breakdown or a timid disposition, easily frightened, emotional, or afraid of the sight of blood; in a few the fact was elicited that they had had a fright in early childhood and that this recurred in dreams. Some gave a history of a neuropathic tendency or inheritance. So that all the evidence goes to prove that an acquired or inborn tendency to neurosis plays an important part in the effects on the central nervous system of exposure to shell shock in a majority of the cases.

Investigations ON CLINICAL THERMOMETRY:

CONTINUOUS AND QUASI-CONTINUOUS TEMPERATURE RECORDS IN MAN AND ANIMALS IN HEALTH AND DISEASE.

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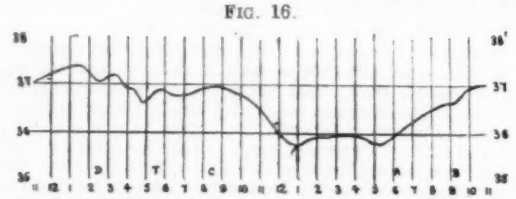
PART IV.*—TEMPERATURE RECORDS IN NORMAL INDIVIDUALS.

ALTHOUGH the number of the recorded observations made on the diurnal variations of the temperature of the healthy human subject is now considerable there is still very incomplete agreement as to what is to be considered a normal curve. For the differences noted Pembrey[78] suggests certain causes. To us the most important of these differences appear to be associated with the conditions under which the observations are made—e.g., the time at which sleep is most profound, the period of greatest muscular activity, and the times and nature of the meals taken by the subject under observation. The importance of these factors will be obvious to anyone who makes a careful examination and analysis of the accompanying charts, not only those on which are recorded the change of temperature in normal individuals, but on those obtained from patients suffering from disease. See Figs. 5, 6, and 16, taken with the Gamgee apparatus, and Figs. 17 and 18, with the resistance thermometer.

RECORDS OF VARIOUS OBSERVERS.

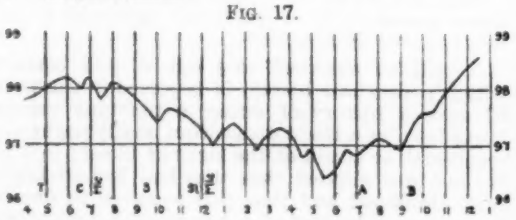
Collecting the figures of 18 observers and combining them with his own, Pembrey shows that there is substantial agreement as to the time of occurrence of the daily minimum temperature, but that there is by no means the same agreement concerning the time of the appearance of the maximum temperature. His own observations lead him to the conclusion that the temperature of a normal man rises during the morning and afternoon and falls during the evening and early part of the morning, and though, as will be seen, our curves do not correspond exactly to those obtained by this observer, they may be said to be in very fair agreement. The following are some of the figures quoted by Pembrey, alongside which are placed three obtained by ourselves and one by Gamgee, three with the thermo-electric couple method, the other with the resistance thermometer.

FIG. 16.



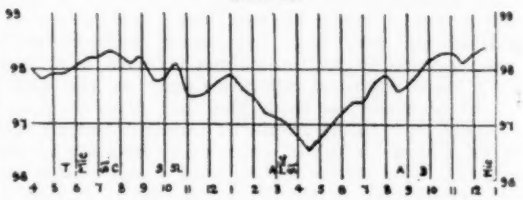
W. M., July 27th–28th, 1912. Record of rectal temperature of normal young man aged 21. This was made with the Gamgee apparatus.

FIG. 17.



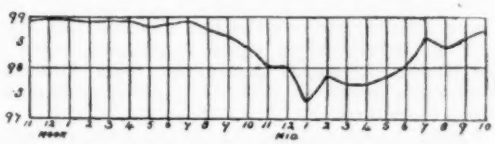
E. R., July 30th–31st, 1914. 24-hour record of normal temperature.

FIG. 18.



E. R., July 31st–August 1st, 1914. 24-hour record of normal temperature.

FIG. 19.



A 24-hour rectal temperature curve made up of 7 superposed curves taken from a normal individual kept in bed during the periods the records were being made. This man fell asleep early in the evening and always awakened in the early morning.

Time of Maximum and Minimum Temperatures.

Maximum.	Minimum.	Range of variations (C.).	Place of observation.	Observer.
8 A.M. to 5 P.M.	About 7 A.M.	1·0°	Mouth.	Davy.
4–8 P.M.	12 midnight to 7 A.M.	0·5°	,,	Allbutt.
About 7 P.M.	About 6 P.M.	0·8°	,,	Ogle.
6–7 P.M.	,, 4 A.M.	0·8°	Axilla.	Bärensprung.
4–9 P.M.	2–8 A.M.	1·3°	Rectum.	Jürgensen.
5–8 P.M.	3–6 A.M.	1·4°	Urine.	Pembrey.
11.30 A.M. to 12.30 P.M.	10 P.M. to 12.30 A.M.	1·6°	Axilla.	Gamgee.
6 P.M. and 4–5 P.M.	About 2 A.M. and 4–5 A.M.	1·24° 1·29°	Rectum, urine.	Pembrey and Nicol.
12 noon to 1 P.M.	About 4 A.M.	1·2°	Axilla.	Woodhead.
About 7 P.M.	,, 3 A.M.	1·8°	Rectum.	,,
12 noon to 1 P.M. 7–8 P.M. only a fraction lower.	5–6 A.M.	1·2°	,,	Woodhead and Varrier-Jones.

The two records taken by us with the Gamgee apparatus were from a healthy man aged 57; the other, taken with the same apparatus, was obtained from Gamgee himself, and the record taken by us with the resistance thermometer was from a man aged 27. On examining four 24-hour "groin" temperature records, of which Fig. 5 (p. 285) may be taken as a good sample, it is found that the highest point (37·8° C.) was reached at 6–7 and 9–10 P.M. Between 11 A.M. and 3 P.M. it ran about 37·4°. The minimum temperature in the four cases is recorded in one at 7–8 A.M. as 36° C.; in

* Parts I., II., and III. were published in THE LANCET, Jan. 22nd (p. 173), and Feb. 5th (p. 281) and 12th (p. 338) respectively.

a second at 4–5 A.M., 36·6°; in a third at 5–6 A.M., 35·8°; and in the fourth at 3–4 A.M., 36·8°. In the same four cases the maximum rectal temperature is reached at 1–2 P.M. (37·8° C.), 6 P.M. (38·25°), 1 P.M. (37·4°), and 4 P.M. (37·4°) respectively, whilst in seven other cases the maximum is reached at 9–10 A.M., 6–7 P.M., 2–3 P.M., 4 P.M., 3–8 P.M., 4 P.M., and 1–2 P.M. The minimum rectal temperature is recorded in the first four cases at 7 A.M. (36·5° C.), 7 A.M. (36·75°), 1–2 A.M. and again at 5 A.M. (35·8°), and 4 A.M. (36·5°). In the other seven cases it occurs at midnight, 1–2 A.M., 3 A.M., 4–5 A.M., 4 A.M., 2–3 A.M., and 1 A.M. respectively. The normal charts (Figs. 5 and 6) (see p. 285) are both very characteristic,† whilst the combined record (Fig. 19) may be taken as that of a "normal" temperature.

Ringer and Stuart[79] state that the average maximum temperature of a man under 25 years of age is 99·1° F. with a diurnal variation of 2·2° F., whilst for men between 40 and 50 there is a maximum of 98·8° and a diurnal variation of 0·87°, although on some days there may be no variation at all. We cannot but think that had these observers been able to take more complete records they would not have rested content with this conclusion, especially as the men they were examining were going about generating and losing heat in various fashions. We say this, although we recognise that our records were taken under very different conditions—i.e., from patients who were confined to bed. Consequently we should not expect quite such a high maximum in our cases, but, again, we should not expect such wide diurnal variations to occur in them as are noted by Ringer and Stuart.

Pembrey and Nicol[80] found that the rectal temperature was never quite so high as that of the urine as it comes from the meatus. An average for 24 hours on a large number of observations gave 98·24° F. as that of rectal temperature and 98·64° as the temperature of the urine. During the diurnal period of greatest activity, 7 A.M. to 11 P.M., the average rectal temperature is 98·58° F., the maximum 99·25°, the minimum 97·03°, and the average variation 2·22°. The maxima of all the observations made by these observers, except those taken immediately after considerable exercise, were 100·6° F., the minima 96·8°, with a diurnal variation of 3·8°.

Ringer and Stuart state that the axillary temperature is practically identical with that taken in the mouth and in the rectum; Parkes and Wollowicz[81] that the rectal temperature is from 0·3° to 0·6° C. higher than the axillary, whilst various other observers place it at anything from 0·1° C. to 0·8° higher. As the result of an examination of a series of 24 records of normal individuals we have come to the conclusion that the greater differences are the more correct. In the same subject we have noted an extreme of 1·8° C. at 7 P.M. when a cup of hot tea had been taken, whilst in the same subject 8 hours later, when sleeping, the variation was only 0·3° C., and 5 hours later still, at 8 A.M., it was only 0·15° C. This subject, a healthy man aged 57, was living under normal conditions, except that he stayed in bed for the 24 hours during which the record was being taken.‡

† In reading them it will be found that all our thermo-couple temperature records are measured in degrees Centigrade, whilst the resistance thermometer records are measured in degrees Fahrenheit. In practice we find that each scale has its advantages, and as yet we have been unable to decide which will be the better scale to adopt.

‡ The figures inserted in the various charts give the temperature in the mouth as measured by the mercurial thermometer. Placed alongside the plotted curve they indicate fairly accurately the differences between the rectal and superficial temperatures.

INFLUENCE OF MUSCULAR ACTION AND OTHER FACTORS.

In both man and animals the rectal temperature may rise a degree Centigrade or more as the result of muscular exercise and great or relatively great bodily exertion, and Hobday[82] found that in the omnibus horse the rectal temperature may be as much as 2° C. higher after a hard day's work than it was at the beginning of the day; whilst Woodhead[83] found that even short spells of muscular exertion by the horse were followed by a distinct rise of rectal temperature. It must be borne in mind, however, that heat production by muscle is going on without cessation, and that the muscles, even when apparently at rest, are in a state of tone, and are the seat of an energetic combustion process, and therefore of heat production.

Jürgensen[84] records that the muscular exertion involved in sawing wood for six hours raised the temperature of a healthy man 1·2° C. above normal. As soon as this work was stopped, however, the temperature fell rapidly. This was observed in the horse also. Increased activity of muscle both voluntary and involuntary is undoubtedly accompanied by heat production, its steady activity accounting for no mean proportion of the whole: 20,000 (Waller[84]) to 60,000 kilogrammetres (Foster[85]) in the 24 hours. The oxidisation of muscle well supplied with blood must be a most important factor in the production of heat, and this heat production, though not confined to the active contracting phase of the muscle, is undoubtedly much more energetic during this phase than during the resting stage of the muscle, and accounts for the considerable rise of the body temperature that invariably follows great or relatively great muscular exertion.

Conversely, anything which leads to the suspension of the activity of the neuro-muscular system—curare, for example—causing muscular paralysis, brings about a fall in the temperature of the body (Tscheschichin, Claude Bernard, and Velten, quoted by Pembrey, loc. cit., p. 841) is accompanied by a great diminution in the respiratory exchange, even if the animal's temperature be artificially maintained. Again, injury of the spinal cord, especially when giving rise to degeneration of motor nerves and paralysis of muscles, is, according to the same observers, frequently accompanied by a marked fall in temperature, both local and general, and "the completeness of the effect seems to depend on the number of muscles paralysed." On the other hand, calorimetric determinations show that muscular activity greatly increases the production of heat and the respiratory exchange.

The rectal temperature in these cases of active muscular exercise may sometimes reach 101° F. in a healthy individual, but Pembrey and Nicol note that such a rise may be accompanied by a slight rise only or even a fall in the temperature in another locality—the mouth—a point of considerable interest in diagnosis. These observers are indeed of opinion that the temperature of the mouth is by no means an exact measure of the deep temperature of the body, and that it is specially unreliable "after exercise or in cold weather owing to the cooling of the mouth," when the buccal temperature may be as much as 3–4° F. below that of the rectum.

McKendrick[86] and Bottomley, using a delicate thermo-electric apparatus, were able to demonstrate the production of heat when hæmoglobin combines with oxygen, and slight though the amount of heat

so generated at any one time or place the total amount must be considerable.

Increased blood flow makes it difficult to determine how far the functional activity of the glandular organs, large or small, of the body, is accountable for the production of heat. The most important of the experiments bearing on this point are those recorded by Claude Bernard,[87] who found (*a*) that the blood flowing from the intestines—i.e., that in the portal vein—has a temperature higher by 0·2° to 0·3° C. than that of the blood in the aorta, but that the temperature of the blood in the portal vein is distinctly lower than that of the blood after it has passed through the liver and is leaving it by the hepatic vein. There can be no doubt, however, that during digestion and muscular exercise the evolution of body heat is always increased. The question of the production of heat, however, appears to be bound up with the balancing or regulation of supply and demand, and is still attracting the attention of many investigators.

SLEEP.

Bärensprung[12] (S. 163) and Wunderlich[5] (p. 109) are of opinion that sleep has no influence on the temperature. Our observations lead us to an opposite conclusion. During the night the body temperature appears to reach its lowest whilst sleep is most profound (see Figs. 16, 17, 18, and 19), and although absence of light, lowered external temperature, lack of food, have all been quoted as factors in the cause of the fall, we find that sleep during the day is undoubtedly accompanied by a distinct lowering of the body temperature independently of any other factors. Here, of course, as pointed out by Jürgensen[64] and Liebermeister,[45a] diminished muscular activity must play an active part, although Liebermeister found that when for ten days he had cultivated a habit of sleeping in the afternoon his temperature would fall 0·8° C. whilst he was asleep, and in this we are in perfect agreement with him. Clothing, by preventing radiation and conversion of heat, undoubtedly has the effect of producing a higher temperature reading, but even this does not interfere with the ordinary diurnal variations when the patient is kept in bed for the 24 hours.

Pembrey holds that the variation of the internal temperature of a living organism follows to some slight extent at least the external temperature variation, though he agrees with U. Mosso[88] and Liebermeister that "habit" is an important factor in this matter. It is evident from a consideration of our charts that what may be called the habitual variations occur even when the subject is confined to bed for the whole 24 hours, for periods of a week or ten days, and we must conclude, as does Pembrey, following Patrizi,[89] that the daily variation in temperature is one of the indications of a corresponding diurnal variation in the activity of the tissues of the body, as shown by the rate of the contraction of the heart, the frequency of respiration, the intake of oxygen, the output of carbon dioxide, "the discharge of urea, and the capacity for muscular work."

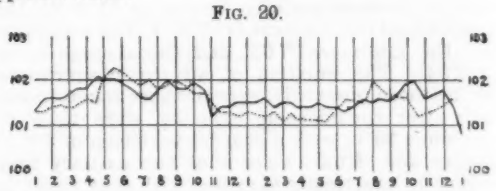
HEAT PRODUCTION AND REGULATION.

We may assume, then, that there is now a fairly general agreement that the muscles and glands and the tissues involved in respiratory change must be looked upon as the factories in which heat is generated in animals, and the chemical changes involved in metabolism—primary and secondary—as its source. Rubner by his calorimeter experiments on the production and giving off of heat, in and by dogs placed on different diets, and comparing the results with those obtained by heat combustion of the same substances, comes to the conclusion that the two are within a very narrow margin the same, and Pembrey points out that in the mean of his experiments we have an indication that the amount of heat as determined by calorimetry is only 0·47 per cent. less than the amount as calculated from the heats of combustion of the different substances which have been decomposed in the animal's body.

Rubner[90] also claims that the production of heat over a given period in warm-blooded animals bears a direct relation to the surface area of their bodies. Whenever heat escapes from the body an attempt is made to compensate for the loss, whilst any interference with such escape is, unless the thermo-regulating apparatus is disordered, invariably followed by a lowered production of heat, and a lessened demand for food, this appearing to be associated with a diminished intake of oxygen and a lowered output of carbon-dioxide. Only in relation to this can we understand how it is that changes in external temperature can have such a marked effect upon the heat production of the body. If, however, we bear these facts in mind, we are in a favourable position to study the effects of bathing, hot and cold, on heat production, and to understand, in part at least, the rationale of the rise and fall of temperature following such bathing.

Our observations on cattle lead us to the conclusion that the surrounding or external temperature has little effect upon the body temperature apart from clothing, exercise, and food, and from loss of tone of the heat-regulating apparatus and centre. In cattle this external heat factor may at certain times of the day induce a slightly higher temperature in winter and summer, whilst at other periods of the day we may note the exactly opposite effect.

FIG. 20.



In Fig. 20 we have a comparison of a couple of composite temperature curves made up of one set of temperature records taken in the winter and of another set taken in the summer. In the early afternoon the summer temperature is from 0·2° to 0·5° F. lower than the winter temperature. At milking and feeding time it rises more rapidly and higher in summer than in winter, and from 5.30 to 7 P.M. it is 0·3° F. above instead of below the winter level at the same time of day. From 8 P.M. to 12 P.M. the two curves are practically identical, but from that point onwards during the night and early morning (the period of low temperatures) the summer temperature is always lower than that met with in winter. Then, when milking and feeding times come, the summer variations are greater than those in winter, the curve rising higher and afterwards falling lower. The explanation of this may be that in winter the cutaneous vessels are in a more "tonic" condition, and that the blood is not allowed to come to the surface nearly so freely as in summer. Consequently the loss of heat is less

and goes on more steadily. It is possible, too, that the animal keeps in health with less exercise.

EFFECT OF FOOD.

Concerning the influence of food on the temperature of the human body, Ringer and Stuart are of opinion that "none of the diurnal variations is in any way caused by the food we eat." Here our observations compel us to question the soundness of this opinion, for we feel that we are justified, from a careful study of the charts of bovines and men, in stating that the ingestion of cold food or water is invariably followed by a fall of the internal temperature and then by a more or less marked rise, even when the subject remains at rest and little heat is being generated by the comparatively inactive muscles (Fig. 16). When warm foods and drinks are given there is almost invariably a continuous and steady rise of temperature for a couple of hours. One of the most notable exceptions is associated with the imbibition of warm alcoholic drinks and will be discussed in a separate paper. Hot tea or hot water alone may bring about a rise of as much as 0·7° C.

A rise, the result of taking food, reaches its maximum usually about one and half hours after a meal and is seldom greater than 0·5° C., about equal to the fall produced by a draught of cold water. In animals there is undoubtedly an increased production of heat as digestion goes on, whilst lack of food is invariably followed by a lowering of the temperature of the starving animal.

In all the records taken after the midday meal the fall of the skin temperature accompanying the rise of the internal or rectal temperature is very marked. As the blood is required at, and flows to, one part or system of the body the vessels of other parts contract. With this redistribution of the blood flow variations in the temperature of the parts involved always occur, and we have evidence in support of the accuracy of certain popular sayings. In this case—

> "Eat till you're cold
> And you'll live to grow old."

To sum up, it would seem that when food is ingested there is a distinct, immediate, and continuous fall in surface temperature. This, accompanied at first by a transient and slight fall of rectal temperature, is followed by a very definite and prolonged rise. As the process of digestion becomes well established, the rise in the internal temperature and fall in the skin temperature become very prominent features of the curves.

INFLUENCE OF AGE.

The temperature falls one or two-tenths between infancy and puberty and then from puberty to middle age, after which it begins to rise until in the eightieth year it is as high as in infancy (Wunderlich[5]). This, however, cannot be accepted as final, as it appears that the relation varies according to the method of taking the temperature adopted and the place at which it is taken. Charcot[91] maintains, indeed, that the rectal temperature is rarely higher or lower in the aged person than in adult, but that in the axilla it may be 2° to 3° C. lower than in the rectum, this evidently resulting from the poor blood-supply to the skin of the aged individual.

REGULATION OF LOSS OF HEAT.

The question of the regulation of the loss of heat is a most complicated one, and one outside the scope of our present work, except in so far as the condition under which the patient is placed, the food and drink he ingests, and the exercise he takes or the work he does, and the covering or surroundings of his body, must always be taken into consideration in determining the importance of variations of temperature at the various periods during the 24 hours. As Pembrey puts it, "An animal may lose heat in various ways—by direct conduction and radiation from the skin, by the evaporation of sweat, by the warming of air during respiration, and by evaporation from the different parts of the respiratory system, by raising cold food and drink to the temperature of the body, and by the discharge of urine and fæces," and, it may be added, in cattle by the discharge of milk.

More than three-quarters of the heat loss from the human body takes place through the skin either by evaporation or by radiation and conduction, from which it is obvious that anything causing contraction of the vessels of the skin, on the one hand, or dilation on the other, must have a very marked effect in diminishing or increasing the dissipation of heat from the surface of the body. Cold or heat, with their action upon the blood vessels, a saturated or a non-saturated surrounding atmosphere, moving or at rest, also play their part in determining the loss or conservation of heat, whilst it has always to be borne in mind that a diminished or increased blood-supply may not only act directly, but may play a fairly important indirect part by lowering or increasing the metabolic processes of the organs or tissues to which they carry nutrient material. Thus when the blood is driven from the skin to the internal organs, not only is less heat lost from the skin because less blood passes through the constricted vessels of the skin and, therefore, more to the internal organs and tissues, whence heat cannot be abstracted as it can from the skin, but we have in the increased blood-supply to the more active glandular organs an extra supply of nutriment to meet the demands of these organs and consequently an increased metabolic source of heat that far more than compensates for the more sparse blood-supply and consequently diminished metabolic activity of the tissues of the skin. Impaired motion, enforced rest, lessened muscular activity, neuro-muscular paralysis, all lead to diminished heat production, and must be carefully considered when interpreting the changes of temperature indicated on a 24-hour record. Above all, it must be remembered that regulation of the temperature of the human body "appears to be associated chiefly with the control of the nervous system over the skeletal muscles and those of the blood-vessels" (Pembrey).

Warmth, rest, exercise, proper food, and the like assume a new importance in the treatment of digestive and other diseases when this question of temperature as an indication of metabolic activity, of reaction to treatment, and of the requirements of the individual are taken into consideration, and without continuous records the full clinical value of thermometric methods cannot be attained.

(To be continued.)

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PARATYPHOID FEVER: ITS CLINICAL FEATURES AND PROPHYLAXIS.

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THERE have been during the past eight months a considerable number of cases of the enteric group in the Mediterranean area. The following account is based on the careful clinical study of a large number of cases in the Dardanelles area. Most of these cases were under observation in the hospitals at Mudros, but some cases also were seen in other parts of the campaign—viz., at Alexandria and Salonika.

The "enteric group" cases showed symptoms of a similar type—viz., headache, furred tongue, rash, and enlarged spleen—and without bacteriological investigation it was at first difficult to say whether many of the cases were typhoid, typhoid modified by inoculation, or paratyphoid. The difficulty was especially great in the mild cases. Happily complete bacteriological investigation was able to be carried out in a large number of the cases of the enteric group, and an analysis of them was possible, so that the paratyphoid cases were able to be differentiated. At Lemnos Major C. I. Martin, R.A.M.C., investigated a very large number of the enteric group cases, and he paid special attention to the agglutination tests which, as carried out by him, were found to be very reliable. Captain R. G. Archibald, R.A.M.C., investigated at Mudros East a large number of these cases, and he has in addition to agglutination tests and bacteriological examination of stools, paid especial attention to cultivations made from the blood of patients. No less than upwards of 150 cases of the enteric group yielded a positive result by cultivation from the blood. A careful clinical study was made of all these cases in which a definite bacteriological diagnosis had been arrived at, and from the clinical symptoms observed a clinical picture could be gained of paratyphoid as it occurs in the Mediterranean. The clinical picture of paratyphoid differs in many respects from that of typhoid, and by careful observation of the points of difference it is possible for a differential diagnosis to be made between the two diseases in many cases.

Proportion of Paratyphoid to Typhoid Cases.

The bacteriological investigation of the cases that came under my notice was most interesting and instructive. It speedily became apparent that of the cases of the enteric group by far the larger proportion were not cases of typhoid at all, but were cases of paratyphoid. The accompanying table of some of the cases in which the organism was obtained from the blood by Captain Archibald gives some idea of the preponderance of paratyphoid over the true typhoid cases. From the figures given it is seen that the typhoid cases were 13·5 per cent., and paratyphoid cases 86·5 per cent.

Captain Archibald's Results of Blood Culture on Cases of the Enteric Group at Mudros Hospitals.

Cases yielding organisms from the blood	141
,, with B. typhosus	19
,, of paratyphoid A organism	67
,, of ,, B ,, ...	41
Cases yielding organisms which culturally were paratyphoid but which did not give typical agglutination reactions—i.e., non-agglutinable paratyphoid cases ...	14

The paratyphoid cases on subdivision gave the following percentages:—

Paratyphoid A	...	47·5 per cent. of total enteric group cases.
,, B	...	29 0 ,, ,, ,, ,, ,, ,, ,,
Non-agglutinable paratyphoid		10·0 ,, ,, ,, ,, ,, ,, ,,

Cases of paratyphoid which yield a positive result by cultivation from the blood are usually cases of a fairly severe type—in other words, the percentage figures for paratyphoid and typhoid, which are in proportion 6·4: 1, expressed the relative frequency of *fairly severe cases* of paratyphoid and typhoid. In my judgment the paratyphoid cases in the Dardanelles area were considerably more than 6·4 times as numerous as the cases of typhoid. My reasons for forming this opinion are that there was a large number of cases of paratyphoid of a quite mild type, in which blood cultures would probably have yielded a negative result since the pyrexia was only of a mild degree. In these cases agglutination tests were done with positive results for paratyphoid. The addition of these cases to those where the organisms were obtained by blood cultures would increase the proportion of the paratyphoid cases to greatly beyond 6·4 times that of the typhoid cases.

It must be clearly understood that the figures in the above series of cases are those of the first 141 cases from which the organism was isolated from the blood, and about which there could be no question as regards diagnosis. With reference to the respective numbers given for paratyphoid A and B these are not to be taken as representing the relative frequency of these two diseases during the whole period. Up to the end of October, 1915, paratyphoid B was much more frequent in occurrence than A, but after the end of October paratyphoid A was much the more common.

In the early part of the Dardanelles campaign the preponderance of the paratyphoid over the typhoid cases was less great, but latterly the preponderance considerably increased, so that during the latter months of 1915 the cases of the enteric group at Mudros were made up mainly of paratyphoid. The reasons for this were: (1) The facilities for spread of paratyphoid by means of carriers of the disease; (2) the lack of protection by inoculation against paratyphoid; (3) the great protection yielded against typhoid by protective inoculations which had by now been most thoroughly carried out in all men of both services. In November and December, 1915, amongst the many enteric group cases at the Mudros hospitals typhoid was comparatively uncommon. The preponderance of paratyphoid amongst the enteric group cases in the Dardanelles was a feature of very great interest, and it illustrated in a most marked way the influence that the prophylactic inoculation against typhoid had on the usual disease-rates of these two diseases.

Continued from preceding page.

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Paratyphoid.

Paratyphoid is a disease of comparatively recent discovery. It was not until 1898 that Gwyn at the Johns Hopkins Hospital isolated from a case with symptoms like typhoid, a bacillus presenting the characters of the paratyphoid organism; he called it the "paracolon bacillus." In 1900 Schottmüller differentiated by special cultural and agglutination tests the paratyphoid A and B organisms from several cases yielding an organism similar to that found by Gwyn. Since that time paratyphoid cases have been met with in relatively small numbers, and the disease has been in the normal conditions of peace in civilised countries a relatively uncommon disease. Thus, Muir and Ritchie[1] say with reference to cases presenting clinically symptoms of typhoid that 3 per cent. of these cases were probably paratyphoid. This remark refers to cases in England where the civil population is not protected against typhoid by inoculation. How different have been the figures in the enteric group cases occurring amongst our troops in the Mediterranean area. *The very great alteration in the ratio of the numbers of paratyphoid to typhoid cases there* is in itself one of the most striking illustrations of the prophylactic value of anti-typhoid inoculation.

Etiology.—The organism paratyphoid bacillus, or paracolon bacillus, as it was called, is similar morphologically to the typhoid and colon bacilli, but can be culturally differentiated from them by their action on media containing different carbohydrates. Paratyphoid A presents some cultural differences from paratyphoid B, the growth on agar of the former being more delicate and transparent.

Agglutination reactions.—By means of these the serum of a patient suffering from paratyphoid may be tested against paratyphoid A and B organisms, when a specific agglutination reaction is obtained with the organism of the type of that causing the disease, but with no other. It is usually necessary for the disease to have been present at least ten days before a specific agglutination reaction develops. The agglutination reaction also serves to identify the organism obtained from the blood culture of a patient suffering with paratyphoid. It should be agglutinated by the serum (even when highly diluted) of an animal which has been immunised by one of the paratyphoid organisms A or B.

Sources of infection: carriers of the disease.—Undoubtedly one of the chief causes of spread of the disease is by means of carriers. A patient who has had an attack of the disease may be a source of infection for months or even years after he has ceased to have any symptoms. The organisms seem to have the capacity of existing in the intestines, gall-bladder, or bladder of some patients after recovery from symptoms of the disease. The original attack of paratyphoid may have been of a quite mild nature, and yet the patient may be a carrier of the disease for a long period after his recovery. Every patient while suffering from paratyphoid, even in a very mild form, is a potential carrier of the disease. Undoubtedly the presence of carriers in a camp is often the cause of the occurrence of paratyphoid amongst troops. Two instances of epidemics of paratyphoid on ships were traced to the presence of carriers in the kitchens. In France numerous cases of paratyphoid A have been traced to the presence of carriers in the troops from India, where this disease is common.[2]

The grave risk of the spread of paratyphoid amongst the patients and personnel of hospitals where there are cases of this disease is well known, and the utmost care is called for on the part of medical officers, nurses, and orderlies. In addition to direct infection from patients, flies are important agents in conveying infection. They carry microbes from the excreta of patients and infect food and drink with the specific organism. Dust, especially in hospitals in the field, may contain the microbes of the disease and contaminate food and drink. Milk may become infected by the excreta of patients *via* flies, dust, &c., or by its handling by carriers of the disease. Water is well known to be a channel of infection if polluted by excreta or contaminated dust, &c.

The excreta of paratyphoid patients or carriers are grave sources of infection, and too much care cannot be taken in military hospitals to prevent infection from this source, both by sterilisation of excreta of patients and constant care and vigilance over latrines and bedpans and urinals. The clothing of patients and carriers may convey infection. Infection may spread from shell-fish obtained from contaminated waters or from meat which has become contaminated with the specific organism. Even tinned meats are not above suspicion. The sea water of harbours, in which there are hospital ships or ships containing patients or carriers, is a possible source of infection. Captain Archibald, in some interesting experiments at Mudros, showed that the paratyphoid organism could live in sea water certainly for short periods. The importance of this observation is great when drinking water for troops has to be conveyed from ships in harbour to the shore by means of water barges; contamination by polluted sea water is difficult to avoid.

Paratyphoid may attack patients of all ages, but the maximum incidence appears to be in early adult life.

Clinical Symptoms.

Cases of paratyphoid of either A or B variety may be divided into three groups:—

Group I.—Cases with usually sudden onset and characteristic symptoms. This is the commonest type of case.

Group II.—The mild cases (often classed as P.U.O., pyrexia of unknown origin) with pyrexia of a mild type, some headache, furred tongue, and slight malaise. Enlargement of the spleen and rash may occur later.

Group III.—Severe toxic cases closely resembling true typhoid.

Symptoms of Cases of Group I.

Early symptoms.—The onset is usually sudden, the patient feeling really ill and unable to work. He takes to his bed within a few hours usually. Chilliness is common, and in many cases shivering occurs, which is sometimes so severe as to be a definite rigor. Giddiness is common if the patient attempts to keep up and about. Nausea and sometimes vomiting are common. The vomiting may sometimes be quite severe at the onset. Diarrhœa during the first two or three days is common. Pains in the limbs and back are a common feature of the onset. These may be so severe as to simulate an attack of acute rheumatism. Abdominal pain

[1] Manual of Bacteriology, 1913.

[2] Clinical Aspects and Diagnosis of Paratyphoid Fever, by Torrens and Whittington, Brit. Med. Jour., Nov. 13th, 1915.

sometimes occurs at the onset, and it may give rise to the suspicion of an attack of appendicitis; it does not usually last beyond two or three days. Headache is one of the most constant symptoms; it is persistent in type but not very acute. It is vertical in distribution, and it usually persists for the first few days. Flushing of the face is common, and the complexion may be distinctly cyanotic in appearance; this is especially so in cases with respiratory complications.

Pyrexia.—The temperature may be quite high—e.g., 103° or 104° F.—and the rise is rapid. There is commonly a marked difference between the morning and evening temperatures, as much as 2° or so, so that the temperature is frequently of the remittent type and the chart has a spiky appearance. The type of pyrexia is illustrated by the accompanying charts. In this type of case the pyrexial period varies; it may last as long as three or four weeks.

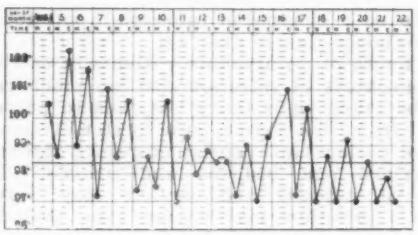
The *tongue* is furred, but usually moist; a dry tongue with brown fur is not common except in the very severe cases (Group III.). In cases of this group the tongue begins to clean from the periphery quite early in the disease; this is an important distinction between paratyphoid and typhoid. *Sordes* on the lips are usually absent.

Pulse.—This is frequently relatively slow compared with the height of the temperature—e.g., a pulse of 70–80 may be present with a temperature of 102° or more. The pulse is low in tension and commonly of a dicrotic type.

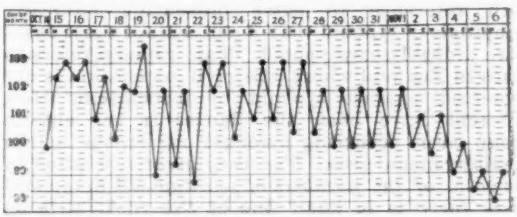
Spleen.—This is enlarged quite early and can usually be felt in the first few days of the disease; the enlargement is quite as pronounced as in typhoid. The percussion dullness of the splenic area is increased. It is important that care should be taken in examination by palpation in order that the splenic enlargement may be detected at the earliest moment. Usually the best method is to stand on the right side of the patient, who has his knees drawn up and abdominal wall relaxed. The left hand is placed behind the lower ribs on the left side and the right hand gently placed beneath the left ribs in the hypochondriac region. The spleen descends with respiration and can readily be felt by the right hand. It is important to note the probable point at which the spleen will descend below the ribs and to direct the attention of the palpating hand especially to this spot. It is

REPRESENTATIVE TEMPERATURE CHARTS.—*Cases Proved by Blood Culture to be Infected with Paratyphoid A.*

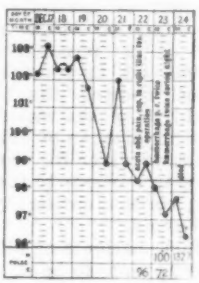
I.



II.



III.



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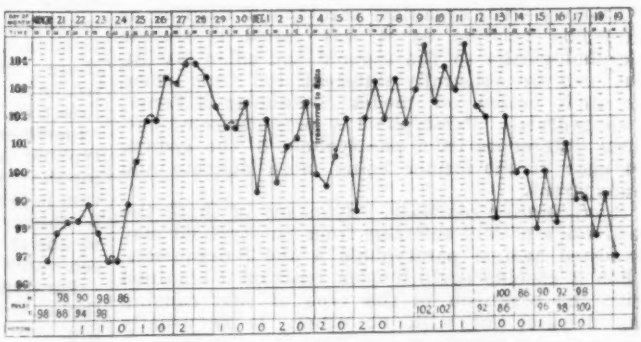

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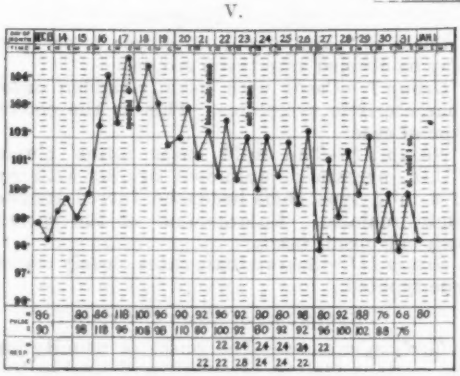

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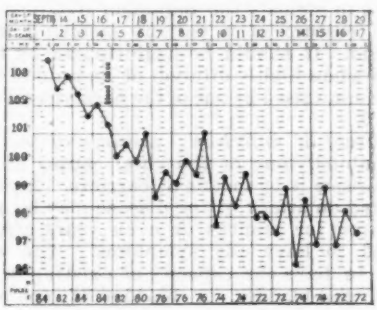


indicated by the position of the percussion dullness of the splenic area.

The *mental condition* is usually bright and clear, and frequently the patient says he feels quite fit except for headache. The *aspect* of the patient is somewhat dull and heavy, but there are not the marked drowsiness and heaviness which are so typical of typhoid. *Reflexes.*—The knee-jerks and abdominal reflexes are usually quite brisk, and remain so throughout the disease. In typhoid it is common to find the reflexes diminished and sometimes absent.

Bronchitis is not uncommon; it is of a mild type and rather a bronchial catarrh without severe bronchial symptoms; rhonchi are heard over the chest and back. *Tonsillitis* sometimes occurs, and deafness, probably due to catarrh of the Eustachian tubes, is not uncommon. *Laryngitis* has been observed as an early symptom in a few cases. *Epistaxis* is occasionally present; it has not been a common symptom in my series of cases.

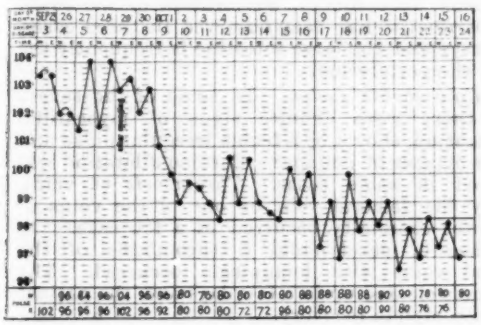
Other symptoms may occur later; they will be referred to below.

Importance of early clinical diagnosis.—The above represent the common early symptoms of paratyphoid, and give quite a typical clinical picture. It is obvious that there is some difficulty in the early stages of distinguishing the disease from influenza, acute rheumatism, malaria, or ordinary catarrhal colds. In the presence of an epidemic of paratyphoid the most careful attention should be paid to *all* the symptoms, and a clinical diagnosis should be made at the earliest opportunity. The clinical diagnosis demands *prompt preventive measures* which should be at once set afoot.

Importance of early bacteriological diagnosis.—It cannot be too strongly insisted upon that bacteriological investigations, with a view to confirming the clinical diagnosis, are of the utmost importance. By means of an early clinical diagnosis the bacteriologist is given the optimal opportunities

REPRESENTATIVE TEMPERATURE CHARTS.—*Cases Proved by Blood Culture to be Infected with Paratyphoid B.*

VII.



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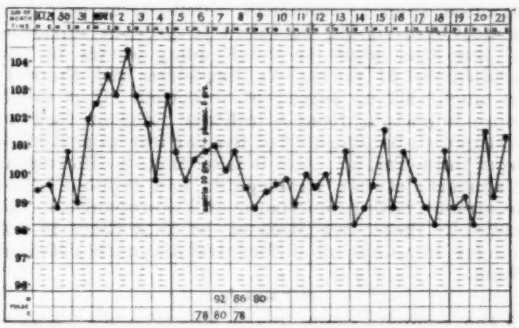

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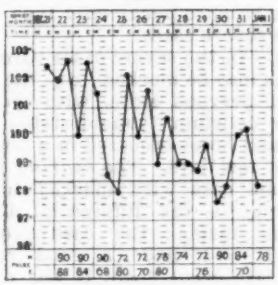

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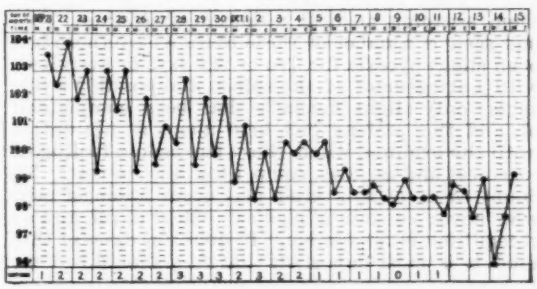

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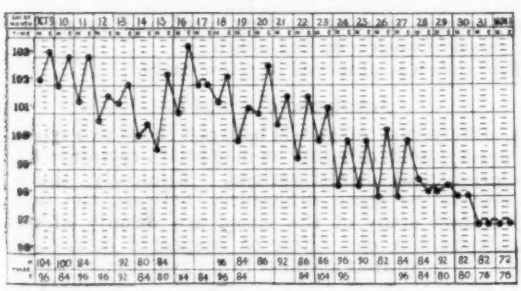

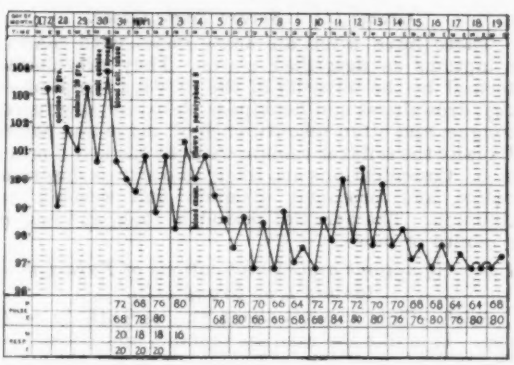

for investigation. Captain Archibald, from his experience at Mudros, has found that the largest proportion of positive results from blood culture is obtained on the fifth day of the disease, but a positive result can commonly be obtained earlier than this. It is by means of blood culture, when the temperature is high, in the early stages of the disease, that the earliest bacteriological diagnosis can be made. The clinician should take care to give the bacteriologist the best opportunity of getting a positive result as early as possible.

The great danger in military warfare, where paratyphoid is so prevalent, is that the disease is mistaken for diseases which are common in civil practice, such as influenza, rheumatism, &c. The utmost care should be taken to prevent mistakes of this kind, since so much delay occurs in the application of preventive measures and there is so much risk of spread of infection. It is much more important, from a military point of view, to distinguish paratyphoid at the earliest opportunity from influenza, &c., than it is to make a differential diagnosis between paratyphoid and typhoid. The treatment, both prophylactic and therapeutic, is the same in these two diseases, so that there is not danger in a delay of differential diagnosis between them.

Group II.

The common symptoms of this type of case have already been mentioned above. Many of these cases are of such a mild nature that there is danger of them escaping medical attention altogether. One has seen a number of these cases where there has been slight pyrexia for five or six days or even less, with enlargement of the spleen and possibly a few spots; only slight headache has been complained of, and the patient has kept about at his duties until the evening, when there has been a feeling of tiredness and malaise, compelling him to rest. No doubt cases of this kind may occur amongst men who never consult a medical officer at all, and so recognition is impossible. In doubtful cases of this kind it is most important that they should be kept in hospital and investigated bacteriologically, otherwise there is grave risk of the spread of infection,

Group III.: Severe Toxic Cases.

These have often an acute onset with marked symptoms as described above. They are characterised by the severity of the nervous symptoms—e.g., drowsiness and heaviness, delirium, dry furred tongue, and often incontinence of urine and fæces. Usually the reflexes remain without marked diminution. Complications are likely to occur as described below, and profound toxæmia and wasting are common. The pyrexial period is long, and may be a month or more.

Later Symptoms and Complications of Paratyphoid (Group I. or Group III.).

Rash.—This appears about the seventh to tenth day. It is like the rash in typhoid, and consists of the typical small rose-red spots which are not raised and fade on pressure. They are distributed over the abdomen, chest, and back. In some cases of paratyphoid, in my series, the spots have been rather larger than those usually seen in typhoid. In a few cases the rash has been quite profuse, and somewhat urticarial in type. The spots usually last about three days, but fresh spots may appear. In a few cases there has been a faint violet-coloured discolouration of the skin in patches, called *tache bleue* by the French clinicians. This is only seen in toxic cases, and is less common than in true typhoid and dysentery.

Gastro-intestinal symptoms.—Tympanites and abdominal distension may occur in the toxic cases, but usually they are absent in paratyphoid. *Vomiting* may occur late in the toxic cases; it is usually associated with dilatation of the stomach. *Diarrhœa* may occur about the third week in severe cases; it is much less common than in typhoid. *Hæmorrhage* may occur from the bowel about the third week in severe cases; quite rarely late epistaxis and hæmaturia have been observed in my series of cases. *Jaundice* is not uncommon; it is usually a late symptom in severe cases. In two cases it was associated with cholecystitis, and in the fluid from the gall-bladder paratyphoid B organisms were found. *Perforation of the bowel with peritonitis* has been observed in three cases. In paratyphoid the large intestine is frequently the site of the perforation.

Cardio-vascular system.—In some of the severe cases there were definite signs of myocardial degeneration, shown by a feeble irregular pulse and serious attacks of collapse. Cardiac dilatation was observed in some cases. *Thrombosis* of veins, usually the femoral vein or one of the veins of the lower extremity, occurred in a few cases. In one case of paratyphoid B thrombosis of the cerebral veins with hemiplegia occurred. The symptoms cleared up in a few days and the patient made a complete recovery.

Respiratory system.—Laryngitis and bronchitis have been mentioned amongst the early symptoms. *Pneumonia of the broncho-pneumonic* type was not uncommon in the severe cases.

Nervous system.—In the severe cases (Group III.) nervous symptoms may be marked—e.g., the patient is in a twitchy, nervous state, with tremulous tongue and a low delirium (typhoid state). Incontinence of urine and fæces occurred in a few cases; it may last for a few days. The *hearing* is often dulled, and in one case with marked headache there was difficulty in the differential diagnosis from acute otitis media; the case proved to be paratyphoid B and made a good recovery. *Meningitis* is of rare occurrence; it was observed in one case and was of the cerebro-spinal type. *Neuritis* occurred in a few cases.

Profound toxæmia.—A few of the severe cases, Group III., showed after the subsidence of the temperature marked wasting, profound toxæmia, progressive weakness, and death.

Parotitis was observed in a few cases.

Paratyphoid A and B.

A differential diagnosis between these two types of paratyphoid can only be made with certainty by bacteriological investigations. Clinically there appear to be some differences between the two types, but many of the cases are exactly alike. Paratyphoid A can often be suspected in a case which is somewhat atypical in its symptoms; thus, the onset in some of the cases of paratyphoid A examined was found to be extremely acute in type, closely resembling a malarial attack. Usually the pyrexial period of the paratyphoid A cases was shorter than those of paratyphoid B, and the complications were of a less severe type.

Relapses are common in both types of paratyphoid; their frequent occurrence calls for the same care as regards diet after the temperature has subsided that one gives to cases of true typhoid.

Bacteriological diagnosis.—This has already been dealt with in the early stages of the disease. (Blood culture.) *Agglutination tests.*—Major Martin found that in many cases a positive result could

not be obtained until about the third week of the illness. The fact that almost all patients have been inoculated against typhoid causes difficulty and necessitates care in the diagnosis by this means. Thus a paratyphoid infection seems to alter to some extent the agglutination reactions to typhoid in a patient inoculated against this disease. However, by doing a series of agglutination tests at intervals of about five days Major Martin found that an accurate diagnosis could be made in paratyphoid cases, though it was not until at least two weeks had elapsed that this was usually possible, and sometimes, as already mentioned, the period was longer. *Examination of urine and fæces* was carried out in some cases with satisfactory results. It was not until the end of the second week of the illness that a diagnosis was usually possible by this method.

Mortality.—Accurate figures of this are difficult to give, since some deaths undoubtedly occur before patients arrive at a given group of hospitals. Probably the mortality is between 3 per cent. and 5 per cent. I am of opinion that as regards mortality and risk to life, paratyphoid A and B are decidedly more serious than is usually believed.

Prophylaxis.

Paratyphoid is undoubtedly at the present time the most important disease to be considered from the military point of view, since by its frequent occurrence at all periods of the year it causes such a large amount of incapacity for duty. It is a *preventable* disease, and every means must be taken to prevent its occurrence. The following are the chief measures which are of the utmost importance and to which attention must be paid in order to stamp out the disease on campaign:—

1. *Early recognition of the clinical symptoms of the disease, and early clinical diagnosis which must be acted upon without delay* by the immediate institution of preventive measures.

2. *Bacteriological investigation* for the early diagnosis of cases and for the recognition of suspected carriers of the disease.

3. *General preventive measures.*—Immediate individual notification of each case to the proper authority as soon as a clinical diagnosis is arrived at.

Immediate measures should be taken by the sanitary staff as regards the disinfection of clothing, bedding, tent, &c., of the patient. A thorough inspection of the camp should be made in order to trace out the possible origin of the disease. Investigation should be made as to the presence of carriers of the disease and of the general sanitation of the camp as regards construction of latrines, refuse destruction, water- and food-supplies, soil pollution, &c.

Isolation of all cases as soon as clinically diagnosed should be immediately carried out. Frequent periodical inspection of the sanitary arrangements of all camps by competent sanitary experts in order to prevent all possible sources of infection.

Hospitals.—Every precaution should be taken as regards the prevention and spread of the disease——e.g., sterilisation of excreta of patients; the utmost care as regards the contamination of water- and food-supplies of all kinds; special arrangements as regards the immediate disinfection of bedpans and urinals used by patients, and also as regards soiled linen, bedding, and feeding utensils.

Nurses and orderlies should receive instruction as regards the care necessary to prevent them infecting themselves or other patients, and printed rules should be issued in this respect. Personal cleanliness and disinfection of the hands of all coming in contact with paratyphoid patients is of the utmost importance, and especially before any food is partaken of.

The possible spread of infection by means of *flies* and *dust* should be guarded against as far as possible. Fly-proof latrines are most important, and the greatest care should be taken in their management.

Water-supplies and food-supplies to troops need special supervision. In connexion with water it is commonly necessary to adopt some chemical means of sterilisation, such as chlorination, combined if necessary with subsequent dechlorination. In short, every precaution which is necessary for typhoid is equally necessary for paratyphoid.

Individual protection.—The value of prophylactic inoculation against typhoid has been proved beyond dispute, and there is every ground for believing that prophylactic inoculation against paratyphoid will be equally beneficial. This valuable measure of individual protection is happily already being carried out by our medical officers upon instructions from the War Office. Most important measures are: 1. Protective inoculation of the personnel of hospitals against paratyphoid as well as typhoid. 2. When re-inoculation of troops is necessary a mixed vaccine protective against paratyphoid A and B as well as against typhoid should be given. 3. The inoculation of troops with a *mixed* vaccine before going abroad.

There is every reason to hope that the above measures will prove effectual in very greatly reducing the number of cases of paratyphoid occurring amongst our troops both at home and abroad.

For valuable assistance in the above work my thanks are due especially to Captain Archibald, who kindly placed at my disposal the important records of his bacteriological work. Also I am much indebted to Major Martin, Lieutenant-Colonel de Crespigny, and Lieutenant-Colonel Stawell, of No. 3 Australian General Hospital, and to Major MacMunn, Captain Heygate, Captain Ross, Lieutenant Coutts, Lieutenant McLoughlan, of No. 15 Stationary Hospital, for valuable help received.

A CASE OF RUPTURED JEJUNUM; OPERATION; RECOVERY.

BY R. P. ROWLANDS, M.S. LOND., F.R.C.S. ENG.,
SURGEON TO GUY'S HOSPITAL.

CONTUSIONS, unlike gunshot and other penetrating wounds, do not so often cause multiple injuries of the bowel, but the individual lacerations of intestine and mesentery are generally more severe. For instance, the small intestine is sometimes completely divided. Therefore it is clear that the hope of recovery without operation is more remote, but that the operation itself is likely to be less tedious and troublesome.

The patient, aged 21 in the Officers Training Corps, was at 9 P.M. on Dec. 29th, 1915, forcibly struck just above the umbilicus by the handle of a hand-cart. This hurt him very much, but he did not fall and he was able to walk to his home, but he did not sleep at all that night and vomited frequently and had dreadful pain in the abdomen, especially soon after drinking anything. Next day he was seen by Dr. G. H. Baird, who sent him to Guy's Hospital in the afternoon. An injection of morphine had been given by another practitioner without affording much relief.

On admission the patient looked very ill and anxious. His temperature was 100° F. and the pulse-rate 110. The abdomen was flat, completely fixed, and exquisitely tender, not bruised, quite resonant in front and over the liver, but a little dull in the flanks, especially the left. The patient was unable to pass urine, but the bladder was not fully distended, only 6 ounces of clear, high-coloured urine being removed with a catheter. A diagnosis of a ruptured small intestine was made, for the signs of peritonitis were much too severe for anything else. Pallor was not very marked.

At 5 P.M. on the same day (Dec. 30th) operation was proceeded with. A very long incision was made to the right of the middle line. Pus and gas at once escaped, followed by brownish, very offensive fluid. There was lymph on the few coils of small intestine which I withdrew in order to find the perforation without delay. Ultimately I found a very large laceration 2½ inches long running obliquely across the dilated œdematous jejunum very high up—that is, about a foot below the duodeno-jejunal flexure. The lacerated bowel was lying far back in the left flank near the spleen. I withdrew it after separating some adhesions, pared the edges, and closed the opening with two continuous fine black threads. Fortunately the mesenteric border had not been divided, but there was a good deal of contusion of the upper part of the mesentery. Meanwhile gauze rolls had been draining away the fluid from the flanks and pelvis, and only the lacerated coil was outside the abdomen. There was general peritonitis. A tube containing a wick of gauze was inserted towards the pelvis through a stab wound above the pubis. The main wound was closed completely in layers after the gauze rolls had been removed. The patient was infused throughout the operation, a pint of normal saline solution being run into each armpit. The operation lasted 20 minutes only, so that the patient's general condition seemed better at the end than at the beginning. The patient made a good recovery in spite of some bronchitis and the escape of a profuse offensive discharge from the abdomen for several days.

Relative Frequency of Rupture in 113 Cases.[1]

Duodenum, 6; jejunum, 44; ileum, 38; "other parts of small intestine," 21; large intestine, 4. While the duodenum and large intestine escape from their sheltered position, the jejunum is most frequently ruptured in its first three feet; the ileum in its last three. Fæcal extravasation is almost invariably present. The most frequent and important complication of ruptured intestine is laceration or contusion of the mesentery; this is important from the rapidly fatal hæmorrhage, or later gangrene. The cases of ruptured intestine fall clinically into three classes: (*a*) The shock never leaves the patient, may never lessen, but pass, rapidly or slowly, into fatal collapse. This may be due (1) to the shock of the accident; (2) to hæmorrhage; or (3) to fæcal extravasation. (*b*) Those in which evident peritonitis develops. The diagnosis is easiest in these cases but, unfortunately, they are not the most common. (*c*) The most common. Instead of evident peritonitis setting in after reaction has taken place, vague symptoms appear, keeping the surgeon in expectation of it, but giving nothing on which he can found a positive diagnosis, for the same slight indications are common in cases in which ultimate recovery has taken place. The patient is apathetic, seemingly satisfied with his condition, and thus misleading; or, getting gradually weaker and therefore being less able to complain, appears to be improving. Peritonitis in this group of cases develops so slowly that its beginning cannot be noted.

James Berry and Giuseppi[2] have done good service by collecting and analysing 132 cases of rupture of the intestine from contusion from the records of ten London hospitals previous to 1908. The intestine is crushed between the spine or ilium and the force employed. The more severe the blow—e.g., such as run-over or a kick from a horse—the more likely is the intestine to be injured.

Cause.

Run-over	51	Kick	16
Squeeze or crush	24	Fall	11
Blow	23	Reduction of hernia ...	1

Site of Rupture.

Large intestine	10	Multiple ruptures, mostly close together	22
Small ,, ...	115	Bowel cut across	15
Duodenum	23	Retro-peritoneal rupture (3 duodenal)	4
Duodeno-jejunal flexure	3	Mesentery torn	15
Jejunum	32	Complications, such as ruptured liver, spleen, or fractured pelvis ...	24
Ileum	32		
"Small intestine" ...	25		
Large and small	4		
Partial rupture	17		

Diagnosis.—The most important symptoms and signs are early and severe pain, repeated vomiting, local tenderness and rigidity, dullness locally or in the flanks. Shock may be extreme, but may be so slight that the patient is able to go on working for several hours. A consideration of the nature of the injury is very important.

Senn[3] draws attention to the possible occurrence of rupture of the intestine from indirect violence, such as falls upon the buttocks, and records the interesting case of a woman who fell upon the right buttock, and six hours later was seized with violent abdominal pain. When Senn saw her two days afterwards she was very ill with general peritonitis, and upon exploring a small laceration of the jejunum was discovered after a long search.

Le Conte,[4] in his address on Surgery before the Philadelphia Academy of Surgery, discusses the diagnosis of intestinal injuries very thoroughly, and lays stress upon the importance and gravity of a steadily increasing pulse-rate, an anxious, careworn, and painful expression of the face, and the recurrence of vomiting after reaction. Brewer also read a valuable paper upon this subject before the New York Surgical Society,[5] and strongly advocated early operation. He places most reliance upon the association of pain, tenderness, and rigidity. Evidence of the presence of free fluid in the peritoneum is also important. Signs of internal hæmorrhage are of the utmost importance. A certain diagnosis is seldom possible for 12 hours or longer, but the surgeon should not wait on this account. The risk nowadays of doing harm by exploring in cases where no laceration of the intestine or mesentery is present is much less than that of waiting to explore until the onset of a septic peritonitis affords certain evidence. As in intestinal obstruction, abdominal section is the only means of clearing up the diagnosis. That the best chance is afforded by early operation is proved by recorded results. It is remarkable that in the above-recorded case the liver dullness had almost completely disappeared owing to the large amount of gas in the peritoneal cavity, but this is an exceptional and late sign.

Prognosis.—This depends on the extent of the injury, the amount of extravasation, and the amount of delay before and during operation. Siegel collected 376 cases which were operated upon, with a mortality of 51·6 per cent. The

[1] Curtis: American Journal of Medical Sciences, October, 1887.
[2] THE LANCET, 1908, vol. ii., p. 1143.
[3] American Journal of Medical Sciences, June, 1904.
[4] Annals of Surgery, 1903, vol. xxxvii., p. 525.
[5] Ibid., 1903, vol. xxxvii., p. 197.

following figures concerning these cases prove the importance and value of early operation:—

	Mortality.
Cases operated upon first 4 hours	15·2%
,, ,, ,, ,, 5 to 8 hours ...	44·4%
,, ,, ,, ,, 9 to 12 hours ...	63·6%
,, ,, ,, later	70·0%

Of Berry's collection 84 patients were operated upon with 67 deaths, a mortality of 80 per cent., but in 15 the ruptures were not found at the operation. Seven of these were in the duodenum. Hence the great importance of carefully examining this part of the bowel and in making a thorough general exploration. This appalling mortality was chiefly due to delay before operation, and the severity of the intestinal and associated injuries, and partly to errors of technique.

The recovery of my patient after such a long interval between the accident causing such a large laceration and the operation is due partly to youth and natural vigour; to the high position of the laceration, where the intestinal contents are less infective; in part to the short duration of the operation, greatly facilitated by making a very long incision; the adoption of simple suturing instead of resection of the bowel, so that the continuity of the bowel, its mesentery, and nerves was not severed, thus preventing interruption of the natural peristaltic wave; and, lastly, to the devoted care of the house surgeon, Mr. J. F. H. Stallman, and of the dressers and nurses at the hospital during the after-treatment.

Queen Anne-street, W.

NOTES ON ALBUMINURIA AND "TRENCH FEVER."

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AT a time when there was comparative quiet in our part of the line I was able to detain most of the sick of the battalion in a farmhouse a little way behind the trenches. Thus an opportunity was given of observing more closely the cases of sudden pyrexia which were always occurring and of detecting several cases of albuminuria. Believing that the two were cause and effect, I collected over a period of three weeks several cases of albuminuria and sent in a report of them, expressing this opinion. At this time such cases were common throughout the corps, and as there were several different suggestions of the cause I thought the following notes might be worth publishing. From the very beginning of the war I have seen in France hundreds of cases of pyrexia of sudden onset, all almost exactly similar and presenting symptoms of influenza. I have no bacteriological confirmation of such a diagnosis, but there was undoubtedly some definite specific infection. The cases reported occurred amongst the sick of my own battalion within a period of only three weeks. The observations were imperfect, the conditions of examination frequently difficult, a cellar or a dug-out often forming the consulting-room, one-and-a-half sturdy test-tubes which had survived the vicissitudes of active service and a little acetic acid being the sole means of determining urinary abnormalities other than those discernible by the naked eye.

CASE 1.—The first case of albuminuria recognised was on April 14th, 1915. Private ——, aged 29, attached to the transport, came to me for the first time with great œdema of the legs, scrotum, and penis. He had had this condition for some days, and the preliminary cause was unknown. Almost every man, however, in the transport had been sick with severe diarrhœa a little time previously, which I regarded as an infectious condition and possibly influenzal. The urine went almost solid with albumin on boiling, but contained no obvious blood, nor was it smoky. There were no evident changes in the cardio-vascular system. I regarded the case as an exacerbation of an old chronic nephritis, and sent the patient to the field ambulance. I came later to regard this diagnosis as probably incorrect.

CASE 2.—The next patient was one of the machine gunners, Private ——, aged 34, who came complaining of palpitation. He had great tachycardia. The pulse-rate was over 140, but the heart showed no murmurs or obvious enlargement. The radial artery, however, was slightly thickened and slightly, but definitely, tortuous. On account of this I examined the urine, but found no albumin. The condition persisted, so I again examined the urine. April 17th: A marked cloud of albumin. 18th: Definite slight cloud of albumin. I regarded the case as one of chronic interstitial nephritis and sent the patient to the field ambulance. I still believe this diagnosis to be correct.

CASE 3.—The third case was Sergeant-Major ——, who came under notice on April 21st. He had marked puffiness under the eyes. I therefore examined the urine and found much albumin, but no blood. There was distension of the stomach, no free fluid and slight œdema of both legs. The patient had headaches, but no thickening of the arteries, no enlargement of the heart, and no accentuation of the aortic second sound. He had come to me a month before (on March 18th), when he had complained of a curious attack rather like a fit, with a temperature of 99·5° F. As I had a great many sick that day, I told him to come later in the day, but he did not do so, and I did not see him again until April 21st. I considered him to be suffering from an acute attack on an old damaged kidney in spite of the absence of apparent changes in the cardio-vascular system, but subsequent cases which will now be taken, caused me to modify this view and to consider it wrong. He was sent to the field ambulance.

CASE 4.—Private ——, aged 23. April 26th: Complained of diarrhœa. Was treated and then detained at the regimental aid-post. 27th: Felt much better, but slight puffiness under eyes noted. Temperature, 99·2° F. Urine: A definite cloud of albumin; no blood; no smokiness. 28th: Temperature, 98·7°. Urine clear. Very definite cloud of albumin. Slight pain in the abdomen. Blood pressure a little raised perhaps. No headache. 29th: Temperature, 98·4°. Diet consisted of milk and eggs. Urine: Faint trace of albumin. 30th: Temperature, 98·4°. Urine: Large cloud of albumin. The patient felt perfectly well; no œdema. Sent to field ambulance.

CASE 5.—Corporal ——, aged 28. April 27th, 1915: Complained of headache and nausea, shivering, and stiffness in limbs, which had come on suddenly. Temperature, 99·2° F. Urine: Definite slight cloud of albumin, clear, no blood, no smokiness. Passed no urine between 10 A.M. and 11 P.M. and then only a little. 28th: Urine: Faint trace of albumin, clear, normal in quantity. Patient felt fairly well; nausea after eating. Looked well. Tongue clean; no œdema; constipated. 29th: Milk diet. Trace of albumin in urine. 30th: Very costive; felt seedy. No albumin in urine. May 1st: No albumin in urine. 2nd: Felt quite well. 3rd: Well; discharged.

CASE 6.—Private ——, aged 30. April 26th, 1915: Temperature 100·8° F. Sudden onset of shivering and pains all over. Diagnosis, influenza. 27th: Temperature normal. Puffy below the eyes. A thick cloud of albumin in the urine. Sent to field ambulance.

In the light of the above cases I sent for another man whom I had discharged to duty some time before, but who had caused me some anxiety.

CASE 7.—Private ——, aged 20. April 8th, 1915: Temperature, 103° F. Sudden onset of pains in limbs, shivering, &c. Diagnosis, influenza. 9th: Temperature, 100·5°. 10th: Temperature normal. Very pale and ill-looking. Given a tonic. 11th: Costive. Given mag. sulph. Still detained. 12th: Temperature normal. Tonic given. 13th: Very pale.

14th: Herpes on alæ nasi. Said he felt perfectly well. Looked ill. 15th: Did not feel well. Looked ill Temperature normal. 16th: Felt better. Discharged to duty. The patient was sent for on April 28th, when there was found to be a definite trace of albumin in the urine. He said that he felt quite well. Sent to duty. 29th: Complained of dizziness on "sentry-go." No rigors. No vomiting. Had cut his hand in bayonet practice the day before. The hand was slightly swollen, and there was pain in the right shoulder. Temperature, 99·4°. Pill No. 9 was given and fomentations applied to the hand. Milk diet. No albumin in the urine. 30th: Felt better, but was costive. Many septic places appeared on the hand. May 1st: The patient looked and felt much better. 2nd: Temperature normal. Still costive. 3rd: No albumin in urine. 4th: Did not feel so well. There had been vomiting through the night. Headache. No albumin in urine. Temperature, 98·8°. Looked ill. Sent to field ambulance.

CASE 8.—Private ——, aged 30. May 2nd, 1915: Temperature, 102° F.; pulse, 156. Pains in legs and vomiting, not a sudden onset; no shivering. The vomiting had begun on the previous day. Tongue clean, slightly dry. 3rd: Temperature, 99·2°. Urine: Thick cloud of albumin, clear, no blood. Face very pale. Milk diet. 4th: Temperature normal. Urine: A very definite cloud of albumin, no blood, no smokiness. Nausea. Great pallor. Sent to field ambulance.

In all these cases, although their absence has not been recorded above, there were no other physical signs of disease discoverable than those mentioned. There was no rash or sore-throat. It will be noted that usually the temperature was normal by the third day and that often there was no excessive rise of temperature, so that the albuminuria could hardly be considered "pyrexial." Hæmaturia did not occur in any of these cases, though I have seen it more than once in the course of this war.

I think the histories of the above cases point to an infective origin of the albuminuria, probably in all the cases, with the exception of Case 2. I believe the infection is possibly influenza. Whatever it was, it attacked man after man and officer after officer, sometimes very severely, sometimes slightly, until it went through practically the whole battalion. The infection may have incidence on the respiratory or the alimentary tract, and involve, I believe, the urinary system. I have seen hæmaturia, hæmoptysis, hæmatemesis, and the presence of blood in the stools. The attack begins with pyrexia, great pain and stiffness of limbs, vomiting or nausea, rigors and headaches, and severe pain in the back. The normal course is for the temperature to fall to normal in three days, after which there are a residual weakness and pallor. In seven or eight days the patient is usually well and fit for work. There may be diarrhœa, or a cough, or very severe bronchitis may develop, which occurred in the cases of more than one officer recently. Herpes labialis et nasi is very common. If the patient is returned too soon to duty he recovers his health slowly and is apt to be breathless and to get dilatation of the heart.

The treatment suggested was a milk diet as far as possible and detention at some farm-house, if conditions permit, so as to avoid overcrowding of the field ambulances and undue loss to the regiment. An examination of the urine should be made, for if there is albuminuria, and if this persists, I believe that if the man so affected be returned to duty he will fall sick again sooner or later and have to be sent down. Moreover, it is, I believe, when albuminuria exists that men remain pale and weak long after the original attack of fever has passed off. Even with an initial temperature of 104° F. there will usually be little or no pyrexia on the third day. I am convinced that aceto-salicylic acid and quinine are of value, with an initial full dose of Dover's powder. In one or two cases in which there was intense pain in the back I found that dry cupping gave great relief. Conditions, of course, may not permit sick men to be retained at regimental aid-posts, but a recognition of the fact that cases even of severe pyrexia soon recover will prevent them being sent too far away from the fighting area.

As there was opportunity for the employment only of the crudest clinical methods of diagnosis and observation, nothing is claimed for these notes but the fact that they are a record of the histories of a few cases of albuminuria, with a suggestion towards their elucidation. Cases such as these, if they pass unrecognised, may cause great anxiety to the medical attendant by presenting without apparent cause grave symptoms of renal disorder.

CICATRICIAL STENOSIS OF THE LARYNX TREATED BY INTUBATION.

BY HAROLD BARWELL, M.B.LOND., F.R.C.S.ENG.,
SURGEON FOR, AND LECTURER ON, DISEASES OF THE THROAT AND EAR, ST. GEORGE'S HOSPITAL, LONDON.

I DESCRIBED a year ago[1] two cases of severe cicatricial stenosis of the larynx treated by intubation, and I now have the opportunity of reporting further on one of these and of describing a third case. I would again draw attention to the "clamped tube" devised by John Rogers and Bryson Delavan, of New York.[2] This is a vulcanite intubation tube (see figure) held in position by a clamp passed through the tracheotomy fistula; the clamp is of white metal, made in two pieces for introduction separately like an obstetric forceps, and has a plug which screws on over the shank to fix it. This arrangement is particularly useful for small children, and has the great advantage of preventing the danger of spontaneous extubation, which would be quickly fatal in the early stage of treatment, and therefore of allowing the patient to be treated at home; while at the same time it keeps open the fistula in the neck, so that a tracheotomy tube may easily be introduced should dyspnœa follow the removal of the tube.

Vulcanite intubation tube and metal clamp.

The child mentioned in my last communication was a little girl 19 months old, who had drunk from the spout of a teapot and had a cicatricial stenosis at the level of the glottis so tight that it was necessary at first to dilate with urethral catheters, then a clamped tube was introduced for

[1] THE LANCET, Jan. 2nd, 1915, p. 16.
[2] Rogers and Delavan: The Treatment of Chronic Laryngeal and Tracheal Stenosis, Transactions of the American Laryngological Association, 1906, and Annual Meeting of the British Medical Association, Laryngological Section, Brit. Med. Jour., Oct. 16th, 1909, p. 1144.

2½ months and removed on Oct. 15th, 1913. I have had the opportunity of examining her lately (on Jan. 5th, 1916) under anæsthesia administered for the removal of tonsils and adenoids. Her voice is loud, but deep in tone like a man's voice and slightly husky; there is no respiratory obstruction, and she took the anæsthetic normally. The cords and ventricular bands show signs of scarring, but the glottis is freely open up to the anterior commissure, and there is no recontraction of the stenosis.

The new case is that of a small boy, aged 3, admitted to hospital on Nov. 30th, 1914, who had had tracheotomy performed during diphtheria seven weeks before. The tube had been removed before his discharge from the fever hospital, and he had marked stertor and cyanosis during sleep. The trachea was opened again through the old scar on Dec. 2nd, and a large granulation removed from the trachea at the site of the old wound; the tube was taken out after 24 hours and the breathing remained good for three weeks, when the symptoms returned. On Jan. 6th, 1915, tracheotomy was performed once more, a new granulation removed, and the cannula left in. The patient was examined with the bronchoscope on Feb. 3rd, and a stricture was found in the trachea. An intubation tube was passed, but as the conical end below the swell engaged the stricture it was constantly pushed out, so the tracheotomy tube was replaced while a special tube was being made. The child developed chicken-pox three days later, and treatment had to be postponed until, on May 4th, a "clamped" intubation tube was inserted and fixed. There was no dyspnœa; fluids had to be taken with a spoon, but swallowing of solids was normal. The patient was sent to the convalescent home on May 19th, and was discharged on June 2nd. He was readmitted a fortnight later because his mother said that the breathing was noisy at night. This was not found to be the case while he was in hospital, but the tube was removed and a clean one inserted on June 17th, and he was sent home on the 22nd. He was brought up again on July 5th with cough, dyspnœa, especially on expiration, and some bronchitis, and was finally extubated on July 7th, having worn the tube for nine weeks. No discomfort followed the removal of the tube, and respiration had been unimpeded up to the time I last saw him on Jan. 14th, over six months after extubation, although there had been some bronchitis during the winter.

In this case I did not have a groove cut on the intubation tube to receive the clamp, and I found it unnecessary, as the clamp gripped the tube quite firmly. It is thus possible to avoid marking the tube while in position through the fistula, removing it to have the groove cut, and subsequently inserting it again. A troublesome procedure, involving an additional anæsthetic, is therefore obviated.

Queen Anne-street, W.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND.—The ordinary quarterly meeting of this association was held on Feb. 17th, under the presidency of Lieutenant-Colonel David G. Thomson, R.A.M.C., and was devoted to a discussion on the Employment of Female Nurses in the Male Wards of Mental Hospitals. Dr. George M. Robertson introduced the subject in a paper, to which reference is made in another column. Dr. J. S. Soutar said that in considering the hospitalisation of asylums it must not be overlooked that a large proportion of the inmates were physically fit and able to render various kinds of assistance, a point further emphasised by Mr. H. F. Hayes Newington. Dr. R. J. Legge, Mr. H. Wolseley Lewis, and Dr. T. Drapes were in agreement with the opener in maintaining the preference of both the patient and his relatives for female care. Dr. J. Brander had found that male patients objected to being nursed by members of a sex who did not understand them, while Dr. Fletcher Beach and Dr. A. W. Neill concurred with the opener. The President in summing up found much of force and truth on both sides. It was possible to exalt the hospital fetish too much, while the man who regarded the asylum as a place *sui generis* was likely to oppose the principle advocated by Dr. Robertson as one of general application in asylums.

Clinical Notes:

MEDICAL, SURGICAL, OBSTETRICAL, AND THERAPEUTICAL.

A CASE OF SHELL CONCUSSION; TREATMENT BY GENERAL ANÆSTHESIA.

BY G. DE H. DAWSON, M.R.C.S., L.R.C.P. LOND.,
RESIDENT MEDICAL OFFICER, THE KING GEORGE HOSPITAL.

IN THE LANCET of Oct. 30th, 1915, there was a note on "Three Cases of Concussion Aphasia: Treatment by General Anæsthesia," in which remarkable cures are shown to have followed this line of treatment. The value of anæsthesia in this connexion is further borne out by the following case, a full record of which is given, as it contains many features of interest and peculiarity.

Private ——, aged 30 years, had been 12 years in the service. On July 8th last he was partially buried by a mine explosion, which killed two of his companions. He was removed to hospital at ——, and on admission he spoke a few sentences, but was quite deaf. He woke up next morning and found that he could neither speak nor read. He took no food for 36 hours after this. On admission to the King George Hospital on July 18th, under the care of Dr. A. G. Phear, he appeared to be in a stuporose condition, but he started violently whenever he was touched. He made signs when he wanted anything, and his behaviour was quite rational. He took no interest in his surroundings and resisted all efforts to arouse him. No signs of organic disease were found. A previous history of a nervous disposition as a child, with "night-terrors" and "fits," was obtained. On July 24th he was given gas for dental extraction, partly in the hope that he would recover his speech by crying out. He struggled violently, but made no sound. At this time he was improving steadily. He could now perceive figures and simple objects. He could comprehend pictures, but shook his head when shown the explanatory text underneath them. He was quite intelligent in a child-like manner. He was fond of games and played them well. On visiting days he would be pleased to see his little boy, but took no notice of his wife. He said afterwards that he did not recognise her. He began now to phonate in a whisper. Shortly afterwards he relapsed somewhat and for a week or so took scarcely any food. He became sulky and melancholic and refused to be aroused. Such relapses, characterised by inertia and complete lack of volition and associated with constipation (which it was difficult to overcome), recurred from time to time, but in spite of these set-backs he went on slowly improving. He became capable of reading short printed words and, later still, handwriting. His nervous irritability diminished and he became more normal in every way. Then for a month he made no further improvement and he seemed to lose heart and the will to get better. He would not even whisper a reply to written questions and his manner was surly and disagreeable. He would brighten up, however, when offered a motor drive or anything else that pleased him. As he ceased to make any further progress it was decided to transfer him to an auxiliary hospital in the country. This was effected, much against his will, on Sept. 13th.

Nothing more was heard of the patient until Nov. 1st, when he was readmitted in a very excited state, shouting and struggling, and obviously under the influence of alcohol. He had obtained a day's leave from the convalescent hospital and had come up to London and had made merry with some friends. In this elated state he began to laugh and then to talk aloud for the first time. He refused to return to the country, and so his friends brought him back to this hospital. When seen in bed some hours later he was still violent, in spite of morphia and other sedatives, and he insisted on seeing me in order to tell me the good news that he had recovered his speech. The function of hearing was still in abeyance, though in the course of rapid conversation when his attention was averted he gave direct answers to some of my questions. He then calmed down and went to

sleep. Next day he was quiet and sensible. He spoke perfectly, but could hear nothing. During the next three weeks he made no further progress, though he said he occasionally caught a sound. With the restoration of his speech there took place also a change in his moral character. He was now bright and pleasant in the wards and had lost all nervous irritability and sulkiness. During these three weeks electrical treatment was tried with a view to the recovery of hearing. Strong galvanic and faradic currents were applied to the ears, with no success, however. It was then decided to try the effect of anæsthetisation.

On Nov. 27th, after elaborate preparation to heighten the suggestive effect, the patient was kept in bed and anæsthetised with gas and ether. He went under quietly, and the administration was stopped as soon as the corneal reflex was abolished. As he was coming round I shouted to him repeatedly that he could now hear quite well. He became very excited and did in fact hear me, and when he realised this he was overcome with joy and had convulsions of a hysterical nature. He soon got over this and henceforth he heard perfectly, but with the right ear only. The left ear on examination showed all the signs of labyrinthine deafness. The patient has been placed on home service, and he returned to duty in the best of health and spirits.

I should like to draw especial attention to the following points:—

1. The onset of mutism and general collapse were delayed until admission to hospital. A similar appreciable interval between the apparent cause and the onset of symptoms has been noticed in other cases of functional disorder.

2. The administration of an anæsthetic within three weeks of the onset of the disorder, while the patient was still in a very shaken state, did no good, but rather aggravated the condition and caused distress.

3. Speech was restored under the influence of alcohol.

4. Recovery of hearing followed the administration of a general anæsthetic when nearly five months had elapsed and other measures had failed.

I am indebted to Dr. Phear and Lieutenant-Colonel R. J. C. Cottell, R.A.M.C., commandant of the hospital, for permission to make use of the notes of this case.

A CASE OF TETANUS OCCURRING IN A SOLDIER TWO MONTHS AFTER BEING WOUNDED.

BY D. PEARCE PENHALLOW, M.D.,
CHIEF SURGEON, AMERICAN WOMEN'S WAR HOSPITAL, PAIGNTON, SOUTH DEVON.

As cases of tetanus which occur many weeks after reception of a wound are rare the following is reported.

The patient, aged 25, Royal Field Artillery, was wounded on Oct. 11th, 1915, by shell fire while in the trenches at Loos. At that time he received as a prophylactic dose of antitetanic serum 750 units and his first-aid dressing. He was admitted to the American Women's War Hospital, Paignton, on Oct. 16th. Examination showed multiple shell wounds of the face, neck, right arm, and hand. These wounds were small and some of them contained small pieces of shell. The right thigh presented on the anterior surface a large superficial granulating wound 3 by 4 inches. The right lower leg just above the external malleolus showed two small infected wounds. There was marked displacement inwards of foot, abnormal mobility and crepitus. Fibula showed fracture 2 inches above external malleolus, and tibia presented an oblique comminuted fracture at the same level.

After admission various pieces of shell were removed, the large wounds of forearm and thigh sutured, and finally healed by primary union. Fracture reduced and held in position by plaster. Patient was apparently making an uneventful convalescence except for condition of leg which was badly infected and was requiring constant treatment.

On Dec. 4th patient was given ether to overcome contracture of his forearm and to correct position of his leg. One week later he complained of some pain in the masseter muscles, but this was thought to be somewhat the result of the etherisation as he had not been breathing particularly well at that time and it had been found necessary to hold his jaw forward with considerable force. Five days later, on Dec. 16th, the pain in the jaw had increased somewhat and patient found he was unable to open his mouth to its full extent. The reflexes were exaggerated, and during the day he had more marked tonic spasm of masseter muscles. It was felt that he probably had tetanus and he was given 1500 units antitetanus serum subcutaneously. Temperature and pulse at this time were essentially normal. On Dec. 18th he was much improved; there was less tonic spasm of the masseter muscles, but he had, and had had since the previous night, clonic spasms of the diaphragm, abdominal and back muscles. Reflexes still exaggerated. Blood count taken at this time showed a leucocytosis of 10,400; differential white count gave the following percentages: Polymorphonuclear neutrophiles, 65; eosinophiles, 6; basophiles, 0; small lymphocytes, 18; large lymphocytes, 5; large mononuclear leucocytes, 3; and transitional leucocytes, 3. Dec. 19th: 1500 units antitetanus serum intravenously. Dec. 20th and 21st: 1500 units antitetanus serum on each day.

From that time to Jan. 1st patient showed steady improvement. At that date the spasms had disappeared, reflexes were normal, there was no pain in the masseter muscles, and he was able to open and shut jaw without any discomfort. He was up and about the ward, walking with crutches. Jan. 20th: Leucocyte count 10,200; differential count gave the following percentages: Polymorphonuclear neutrophiles, 72; eosinophiles, 3; basophiles, 1; large lymphocytes, 4; small lymphocytes, 16; large mononuclears, 1; and transitionals, 3. White count made a month after last inoculation shows practically the same leucocyte count, but the eosinophiles are approaching normal.

It is interesting to note that both the eosinophile and leucocyte count are increased, but it is doubtful whether very much stress can be laid upon this, owing to the fact that the patient has a septic wound in his leg which is still discharging. According to Hill in the *Archives of Internal Medicine* for December, 1915, there is in cases of tetanus an increased leucocyte but a diminished eosinophilic count. It is also interesting to note that as soon as the antitetanic serum was given the patient immediately began to show signs of improvement, and although a total of only 6000 units was given he made a complete recovery.

Medical Societies.

ROYAL SOCIETY OF MEDICINE.

SECTION OF OTOLOGY.

Exhibition of Specimens.—Septic Meningitis following Chronic Suppurative Otitis Media.—Otogenic Facial Paralysis.

A MEETING of this section was held on Feb. 18th, Dr. ALBERT A. GRAY (Glasgow), the President, being in the chair.

The PRESIDENT showed sections from four cases of Otosclerosis in whom the duration of the condition had been respectively 1 year, 3 years, 25 years, and 60 years. In the case of one year's standing the changes differed from those ordinarily seen in otosclerosis in that there was no deposition of bone, only absorption; hence the diseased parts scarcely stained at all. All that was left were a few blood-vessels and broken-down bone cells. Possibly the absence of deposition of bone in this case was due to the patient being the subject of advanced phthisis. In the case which had existed three years phthisis was present also, but only at an early stage. In this section the newly formed bone stained deeply and was very sharply demarcated. There was no fixation of the stapes. In the third case the stapes was ankylosed. In all the cases there was but a very fine bridge of bone uniting the stapes to the oval

window—i.e., only some 15μ to 20μ. In the last case, that of a woman aged 80 years, the rarefaction had proceeded so far in the wall of the labyrinth that there was practically no bone left behind the foot-plate of the stapes. There had obviously also been a deposit of bone, and the absorption in her case had clearly been due to osteoplasts, not to simple pressure as was claimed by Manasséz. In none of the sections was there any sign of inflammatory activity. The tympanic membrane, the organ of Corti, and the ganglion spirale were normal in all four cases. His own view was that there was a change in the nerve structures associated with this condition, but so far our methods were not such as would enable these to be detected.

Mr. SYDNEY SCOTT exhibited preparations from the labyrinth and tympanum of a soldier who suffered from deafness in consequence of a bullet wound received in the vertex of the skull, and whose death was due to meningitis. Post mortem, intra-tympanic hæmorrhage was found on the right side, but none within the labyrinth. As soon as he was struck he became deaf, but experienced loud buzzing noises in the ears. There was no paralysis of the face or limbs, and the reflexes, both superficial and deep, were normal. Left hemiplegia developed a fortnight after admission, and this was not relieved by the removal of fragments from the fractured parietal bone. There was extensive softening of the right cerebral hemisphere, and portions of it were infiltrated with pus; but nothing was found which could be held to account fully for the deafness.

Sir WILLIAM MILLIGAN related a case in which septic meningitis followed chronic suppurative otitis media. The patient, a man 27 years of age, was admitted to hospital with the complaint of a discharge from the left ear, violent headache, and vomiting. There was a history of tuberculosis and pneumonia earlier in life. The complete post-aural operation was followed by a rise of temperature to 104° F., and the patient was very delirious and noisy. Lumbar puncture showed that the cerebro-spinal fluid was under pressure, but, though it contained pus, no organisms were found, nor could any be cultivated from the fluid. Ten days' tappings still continued to yield turbid fluid. Ice bags were applied to the head, and 20 grs. of urotropine were given every four hours. A fortnight after the operation the patient was in a critical condition and saline enemata with brandy were given. Recovery ensued three months after admission, and Sir William Milligan considered that the chief factor in this was the frequent lumbar punctures.—Mr. J. F. O'MALLEY suggested the possibility that the case was one of cerebro-spinal fever, a case of which disease he narrated which had somewhat similar symptoms.—Mr. SCOTT thought it might be of influenzal origin, though the isolation of the causal micro-organism of that disease was notoriously difficult.

Dr. DAN MCKENZIE related the particulars of an instructive series of cases illustrating the occurrence of otogenic facial paralysis. He spoke of the small attention paid to this subject in English text-books on otology and in otological literature. Some cases of paralysis of the nerve were due to curettage in the region of the internal auditory meatus; in some there was injury to it following aural operations, while in others concussion seemed to be the only cause. However severe and hopeless appeared to be the palsy soon after the nerve injury, in most cases definite benefit accrued at periods more or less remote, sometimes as long as seven years. Sometimes the curettage had to injure the nerve, otherwise some diseased tissue would be left behind, and it was well to bear in mind the more hopeful outlook in regard to recovery from the facial palsy.—In the ensuing discussion the PRESIDENT, Sir WILLIAM MILLIGAN, Dr. H. J. B. DAVIS, Mr. W. STUART-LOW, Dr. J. DUNDAS GRANT, Dr. W. JOBSON HORNE, and Mr. SCOTT took part, and Dr. MCKENZIE replied.

ROYAL ACADEMY OF MEDICINE IN IRELAND.

SECTION OF MEDICINE.

Acute General Tuberculosis, with Left Oculo-motor Paralysis, after Measles.—Chyluria.

A MEETING of this section was held on Feb. 4th, Professor JAMES A. LINDSAY, the President, being in the chair.

Sir JOHN MOORE reported the case of a girl, aged 4½ years, in whom measles nine weeks before her admission was followed by "broncho-pneumonia," and suddenly and finally by complete paralysis of the left oculo-motor nerve. She was sent to hospital on Jan. 5th by Dr. Ella Webb. On admission the axillary temperature was only 96° F. The pulse-rate was 86, and the respirations were 28 per minute. The child was quite conscious and very intelligent. She answered questions more by gestures than by speech. Her tongue was thickly coated. There was complete paralysis of the left third nerve: absolute ptosis, wide dilatation of the left pupil, inability to turn the eye inwards or upwards, slight external strabismus, and loss of power of accommodation and of contraction on exposure to light. The fourth and sixth nerves seemed to be unimpaired in power and function. Dr. Euphan Maxwell had confirmed these observations, and suggested congenital syphilis as a possible cause of the condition. Strength failed rapidly. The abdomen shrank and became scaphoid. Vomiting set in, and finally complete unconsciousness ended in death on Jan. 15th. Mr. R. M. Brontë reported the post-mortem findings as follows: "Disseminated tuberculosis of both lungs and also of the mediastinal glands. Very profuse tuberculosis of the pericardium, diaphragm, liver, kidneys, spleen, and peritoneum. Extensive basal meningitis." After hardening a histological examination of the nucleus of each third nerve was made, but no evidence of tuberculous mischief was forthcoming at that point or in the intracranial course of either oculo-motor nerve. As the left eyeball was not removed it is not possible to state what was the condition of the corresponding oculo-motor nerve in the orbit or within the area of its final distribution.—Dr. J. LITTLE thought that the child was probably on the eve of a tuberculous outbreak before she contracted measles.—Dr. ELLA WEBB inquired whether the broncho-pneumonia was of ordinary post-measles type or was likely to have been tuberculous throughout.—Dr. EUPHAN MAXWELL said that the signs in the left eye—namely, complete third-nerve paralysis and commencing optic atrophy—were obviously due to the pressure of the exudate at the base of the brain. The patches of choroidal atrophy in the left eye probably marked the site of previous metastatic tuberculous inflammations. The signs in the right eye—namely, internal third-nerve paralysis and slight congestion of the inferior veins at the disc margin—were probably also due to basal pressure. Although theoretically the involvement alone of this small portion of the third nerve, in which also run the fibres to the inferior oblique, seems strange, it would seem that clinically it is not uncommon.

The PRESIDENT read notes of a case of Chyluria, and said that this condition, well known in certain countries as the result of infection by Filaria bancrofti, was occasionally seen in the British Isles in a non-parasitic form. Little was known of the pathology of the disease. His patient was an exceptionally vigorous and energetic man, who had always enjoyed excellent health till about three years ago, when he noticed that his urine was frequently milky in the morning. This also occurred after fatigue, a full meal, or mental worry. By limitation of excessive activity, moderation in diet, and taking precautions against sleeping on the back, the chyluria had now practically disappeared.—Dr. WALTER G. SMITH said that in chyluria the fat was present in a very fine emulsion, and the condition was independent of diet. It had been observed in very diverse conditions—for example, pregnancy and cancer of the stomach. In lipuria the fat occurred in more massive form and did not remain in emulsion. Lipuria had been found in obesity, diabetes, hæmatoporphyrinuria, &c. A third very interesting form in which fat might be found was as liquid crystals, which could be differentiated only by means of polarised light.—Dr. H. T. BEWLEY said he had a case of chyluria some years before in which the urine was exactly similar to the specimen shown. On some occasions the urine solidified into a jelly in the vessel in which it was placed. He had found all forms of treatment quite useless.—Dr. R. J. ROWLETTE mentioned a case the urine of which he had examined on several occasions at the Rotunda Hospital. The patient was a negress who had never been abroad. She was in perfectly good health otherwise.—The PRESIDENT, in reply, said he thought it a mistake to give a fatty diet, as had been recommended in several text-books. His patient was a strong, vigorous man, and he advised abstention from fat and reduction of exercise.

SECTION OF PATHOLOGY.

Exhibition of Cases and Specimens.

A MEETING of this section of the Royal Academy of Medicine in Ireland was held on Jan. 21st, Professor E. J. MCWEENEY, the President, being in the chair.

The PRESIDENT referred to a case of Food-poisoning due to Bacillus Suipestifer which he had already described in November last as one of food-poisoning due to paratyphosus B. His subsequent study of the causal organism showed that it was really a suipestifer, capable of being distinguished from paratyphosus by both agglutination and absorption tests, diagrams of which he demonstrated.—Professor METTAM said that B. suipestifer was not uncommonly found in swine-fever, though the primary cause of the disease was an ultra-microscopic parasite.

The PRESIDENT also showed a case of Extensive Hæmorrhagic Infarction of Small Intestine. The patient, a very obese woman aged 60, with a small umbilical hernia, was admitted to hospital on Jan. 12th. Her previous history was good. At 11.20 A.M. on the day of admission she was seized with violent epigastric pain; at 2.30 P.M. she took some whisky, which made her worse. She had had a motion earlier in the day, and an enema produced a copious action of the bowels. She vomited once only. There was nothing to point to intestinal obstruction. Her pulse and temperature were normal on admission. The urine contained some albumin. About ten hours after admission the patient became collapsed and died quite unexpectedly. At the necropsy the small intestine was found in a state of complete hæmorrhagic infarction from about the middle of the jejunum to a few feet above the ileo-cæcal valve. The corresponding mesentery was also much thickened and infiltrated with blood. The infarction began quite suddenly at a spot where there was a groove across the bowel, as though it had been pressed upon, though not obstructed, by a band. No band was, however, found. The coils of intestine below this were very thick and rigid, almost black in hue and distended with liquid blood. Towards the lower end of the ileum the process gradually ceased and the coils were of normal appearance. Owing to the extreme acuteness of the process there was no peritonitis. Dissection of the affected mesentery revealed no abnormal condition of the arteries. The smaller veins were distended with soft black clot, but the question arose as to whether it could be regarded as ante-mortem. There were no adhesions and no Meckel's diverticulum, nor was there anything in the nature of a volvulus discovered. The cause of the intense engorgement, and the nature of the band which had undoubtedly pressed upon the bowel, remained unexplained.—Mr. R. M. BRONTË said he had brought forward an almost similar case at the last meeting of the section, and had met with two other cases recently which varied only in the extent of the lesions, the cause being similarly obscure.—The PRESIDENT, in replying, said he regarded the condition as one of thrombosis, but as death had supervened so rapidly there had been no time for the clots to become adherent to the vessel walls, as in typical ante-mortem clotting.

Dr. J. H. POLLOCK demonstrated specimens from a case of Prostatic Carcinoma with metastases in the lumbar glands and liver. The patient when admitted to hospital had complete retention of the urine. Catheterisation was found impossible, and suprapubic puncture was performed. He died shortly after admission. At the post-mortem examination the liver was found to be studded with comparatively small carcinomatous nodules. The entire column of the lumbar glands, from the under surface of the liver to the brim of the pelvis, was one white hard mass, which caused substantial aortic compression. A similar large mass was found within the pelvis upon the left side. Upon cutting open the prostate it exhibited an atypical structure suggesting carcinoma. Histological sections from the primary growth and secondary deposits showed typical alveolar carcinoma.—The PRESIDENT considered it unusual to find metastases in the liver, but common to find them in the lumbar glands.

Mr. T. T. O'FARRELL showed a specimen of Bothriocephalus Latus. The patient from whom the specimen had been taken lived on the banks of the River Shannon. The man had suffered for some time from vague symptoms of "indigestion," but had no pronounced anæmia. He passed the first segments of tapeworm at the end of December, 1915. The usual anthelmintics had been given and the whole worm was passed; he failed to find the head, but the smallest segments were presented for examination. The following facts were elicited from the patient. 1. He had always resided in Ireland except for three trips to England and two to Scotland, each of about five or six days' duration. On these occasions he did not partake of fish. 2. He had frequently eaten fish taken from the Shannon—namely, perch, pike, bream, roach, also eels, but no trout so far as he remembered; they had not been undercooked. Mr. O'Farrell said this was the first specimen he had seen in Ireland, and he had not seen any previous record of the presence of this parasite in Ireland. The tapeworm he had frequently met with was the T. saginata.—The PRESIDENT said the tapeworms he had met with were mainly T. saginata and a few T. solium, but he had not met with the Bothriocephalus latus.—Professor METTAM regarded this parasite as practically unknown in Ireland. He was interested to hear the common finding of T. saginata in man, as he had never seen the Cysticercus bovis in animals brought to the Royal Veterinary College.

LONDON DERMATOLOGICAL SOCIETY.—A meeting of this society was held at St. John's Hospital for Diseases of the Skin on Feb. 15th. Dr. J. L. Bunch, the President, being in the chair.—The President showed, among others, the following cases: A woman, aged 51, with Generalised Scleroderma associated with Rheumatoid Arthritis; a woman, aged 27, with Localised Scleroderma (the patient received a blow on the right leg seven years ago; she had now an increasing shiny patch present on the lower anterior third of the right shin).—Dr. Morgan Dockrell showed a case of Congenital Syphilis (the lesion was confined to the right hand); also a case of very extensive Lichen Planus in a woman aged 26 (the condition had been present for three months and the early papules were especially well marked on the wrists and legs and were seen running into one another).—Captain W. Griffith, R.A.M.C., showed a case of Local Hyperidrosis of the Face. He said that he had seen three cases of this kind, that the patients sweat irrespectively of the temperature, and that they mostly complain of shock and are usually neurotic. He regarded the condition as being a functional disease of the nervous system.—Dr. W. Knowsley Sibley showed a woman, aged 67, who had marked areas of Scleroderma present on the body and typical patches of Psoriasis on the knees and elbows, the interesting points being the association of the two diseases, and that the scleroderma preceded the psoriasis by two years.—Mr. Christopher Kempster showed a case of Melanotic Sarcoma in a man aged 50. The pigmented nodular lesion on the right arm had been present for ten years. Mr. Kempster considered that the most successful way of treating the lesion was by applications of the X rays.—Dr. J. H. Phibbs showed a case of Syphilitic Keratosis in which the soles of the feet and the palms of the hands were affected.—Captain C. H. Mills, R.A.M.C., showed a case of Para-psoriasis on Plaques of Brocq. The eruption was of a pale pink colour with very slow evolution, almost complete absence of pruritus and infiltration of the derma, and a fine pityriasic desquamation, extremely resistant to local applications. The disease was absent from the face and scalp and elbows and knees.—Dr. Sibley read a paper on the Treatment of Scars. He described how scars could be locally influenced by the application of modern physical and electrical agents, such as (1) hyperæmia, (*a*) Bier's suction cups, (*b*) radiant heat, (*c*) hot air (moist, steam), (*d*) hot air (dry), hot air douche, (*e*) compresses (hot or cold); (2) massage; (3) desquamating and exfoliating agents, such as salicylic acid and resorcin; (4) electrical treatments which could be used were ionisation, X rays, radium, and high-frequency currents.

THE LATE SURGEON-COLONEL E. A. GIBBON.—Surgeon-Colonel Edward Acton Gibbon, who died suddenly at the age of 82, was high sheriff of Co. Wexford. Qualifying in 1860, he at once entered the Army Medical Service, spent several years in India, and retired in 1881 to Co. Wexford, where he was landowner and magistrate.

Reviews and Notices of Books.

Rhizopod Protozoa, the Cause of Cancer and Other Diseases: Being Part IV. of "Protozoa and Disease"

By J. JACKSON CLARKE, M.B.Lond., F.R.C.S.Eng., Senior Surgeon to the Hampstead and North-West London Hospital. Illustrated. London: Baillière, Tindall, and Cox. 1915. Pp. 187. Price 7*s.* 6*d.* net.

IN all matters of scientific controversy great services are rendered by a vigorous minority, and such Mr. Jackson Clarke again declares himself in this interesting work, beautifully illustrated by himself. With much enthusiasm and trenchancy he inculcates the doctrine that "anyone who looks seriously for protozoa in cancer will find them in abundance." He bases this opinion on a study of the Mycetozoa, especially *Didymium difforme* and the comparison between the microscopic appearances presented by that organism and those found in malignant tumours. Incidentally proof is adduced in favour of the protozoal origin of molluscum contagiosum and syphilis. As regards molluscum contagiosum, evidences of vitality of the molluscum bodies are based on the author's observations on material kept in water and nutrient liquids; signs of vitality on the part of the contagium are, among others, segmentation, protoplasmic commotion, the formation of oil-like subdivisions, &c. The author says: "A last evidence of vitality is the formation of great numbers of greenish globules. ..... I regard them as a phase of the protozoon in a complete chromidial state." In chorio-carcinoma it is stated: "I have found a definite structure which can hardly be anything save an amœboid protozoon." In this connexion the frequent existence of nuclear dust, chromidia, in protozoal cells, replacing the ordinary nuclear structure, is emphasised, and a chapter is devoted to chromidial formations. As to the familiar "bird's-eye bodies" in cancer cells, "That they really are protozoa formed from chromidial masses can be proved by any observer who will take the trouble to examine patiently scrapings of cancer or precancerous syphilitic lesions on a warm stage." As to an X ray cancer, "there are none of the protozoa in it." With regard to syphilis, the author, in speaking of McDonagh's observations on intracellular protozoa in this condition, says: "I can identify some of them with the bodies which I demonstrated to the Pathological Society in October, 1894," and again, "Some of the phases photographed and drawn by McDonagh in syphilis are identical in form with bodies that I described as protozoa in human cancer and sarcoma, and in the infective sarcoma of the dog."

These excerpts will enable the interested reader to appreciate the scope and tendency of this work; they show how different from the generally accepted view are the interpretations which certain observers attach to particular structural appearances. The existence of controversy of this kind shows up in the clearest light the failure of present-day histological methods to solve the problem of the causation of malignant tumours.

Diseases of Nutrition and Infant Feeding.

By JOHN LOVETT MORSE, A.M., M.D., and FRITZ B. TALBOT, A.B., M.D. London: Macmillan and Co., Limited; New York: The Macmillan Co. 1915. Pp. 346. Price 10*s.* 6*d.*

THIS little work deserves the attention of all those who take an interest in the science of infant feeding. It is in some respects the best compilation of exact knowledge on this subject with which we are acquainted, though the human infant is regarded too much in the light of a laboratory animal which can be trusted to keep up certain standards of work and to maintain some uniformity of conduct. The opinions expressed are almost too judicial, too abstract—in fact, the whole book reads a little like a text-book of physiology. It would have been satisfactory if the expectations raised by laboratory experiments had borne more fruits in the wider field of clinical realisations.

The general arrangement of the book is as follows: The first 70 pages are given up to physiology and metabolism, the next 50 to breast-feeding, then follow 90 pages on artificial methods of feeding, while the two concluding sections of 70 and 40 pages are devoted respectively to gastro-intestinal troubles and nutritional disorders. In dealing with artificial feeding the authors submit that the composition of the food must be adjusted to suit the physiological requirements of the individual baby, and that failures must follow by adherence to hard-and-fast rules. Very rightly they insist on the advantage of calculating the daily requirement in calorie values, although they realise that the percentage "make-up" of a feed may have important bearings on the processes of digestion.

In view of certain laboratory experiments carried out by one of the authors, it is pointed out that the daily output of work by the infant greatly modifies the daily ration which should be supplied. The metabolism of an infant sleeping quietly is very different from that of an active, crying, or fretful baby, and the daily allowance in the two cases is, or should be, quite different. The authors, however, do not refer to the variations in food requirement introduced by variations in external temperatures. The metabolism of an infant in the park must be quite different from that of an infant in the calorimeter, or in the stuffy room of a slum. The clinical treatment of the various nutritional disorders dealt with in the last sections of the book is the least satisfactory. The dietetic expedients recommended appear too circumscribed, they are almost exclusively confined to simple modifications of cow's milk. Metabolism itself is often uncertain, coy, and hard to please; it must be humoured and stimulated by variety. In this branch of practical pædiatrics the methods of English clinicians deserve more acknowledgment than they receive at the hands of the authors.

MISCELLANEOUS VOLUMES.

OUR readers will not have forgotten Sir William Osler's eloquent tribute to his friend, and now we have Trudeau's record of his own life (*An Autobiography*. By EDWARD LIVINGSTON TRUDEAU, M.D. Illustrated. Philadelphia and New York: Lea and Febiger. 1916. Pp. 322. Price $2), written with little art but with a frankness and sincerity that is very moving. Trudeau inherited from his father the same love of wild nature and of hunting that had spoiled his father's professional career; but this was to save the son's life by enabling him to live contentedly in a wilderness during the first five years of his illness, just the sort of life that was best adapted for his restoration to health. The illness was, of course, phthisis, which was announced to him soon after his marriage and just as he was starting practice in New York. He describes the interview in the following words: "Even at that early date Dr. Janeway's great skill in physical diagnosis was recognised, and he had a class at Bellevue for physical diagnosis to which I belonged. He received me cordially and began the examination at once. When this was concluded he said nothing. So I ventured, 'Well, Dr. Janeway,

you can find nothing the matter?' He looked grave and said, 'Yes, the upper two-thirds of the left lung is involved in an active tuberculous process.' I think I know something of the feelings of the man at the bar who is told he is to be hanged on a given date, for in those days pulmonary consumption was considered as absolutely fatal. I pulled myself together, put as good a face on the matter as I could, and escaped from the office, after thanking the doctor for his examination. When I got outside, as I stood on Dr. Janeway's stoop, I felt stunned. It seemed to me the whole world had suddenly grown dark. The sun was shining, it is true, and the street was filled with the rush and noise of traffic, but to me the world had lost every vestige of brightness." Trudeau's account of his own feelings reminds one of a similar passage from another American doctor who was apt to incorporate in his books scenes of his personal experience. Dr. Weir Mitchell is describing[1] in one of his novels the feelings of his hero when he has just learned of his hereditary taint of madness: "At first there was in all his heart a sea of nameless passion, pent up for years, and only set free for a moment, to be ordered at the next into quiet by a voice to him as potent as that which stilled the raging waters of Galilee. Then came for a while, or at intervals, that strange sense of being morally numbed which is like the loss of feeling mercifully bestowed on the physical system by the blow of the lion's paw." Although at first stunned by his blow, Trudeau tells how it was not long before a new hope began to grow, a hope which it was part of his life's work to help develop and to demonstrate to those in similar case. The story of how this came to pass and how he worked out his own salvation and that of others at Saranac, on the Adirondack Hills, is the main theme of his book. There is more of tragedy in the loss of three of his four children, two of them from his own complaint, and in the burning down of his house and laboratory, the scenes of his early pioneer labours; but in lighter strain is the account of R. L. Stevenson's visit to Saranac Lake and his gift on leaving of a book, suitably inscribed, to each member of Trudeau's family. To the doctor himself the dedication ran: "Trudeau was all the winter at my side: I never spied the nose of Dr. Hyde," in a copy of "Dr. Jekyll and Mr. Hyde." In his concluding chapter, written with foreknowledge of his approaching end, Trudeau sums up his personal experience of phthisis in the words: "And yet the struggle with tuberculosis has brought me experiences and left me recollections which I never could have known otherwise, and which I would not exchange for the wealth of the Indies! While struggling to save others, it has enabled me to make the best friends a man ever had." To the many who have been through a similar experience Trudeau's book will especially appeal. All will read with profit the life of a man who, in the words of Dr. S. A. Knopf,[2] was a master of phthisiotherapy in general, a saviour of countless lives, and last, but not least, the teacher of a large number of men who are now carrying on the work in all parts of the United States of America.

We have recently been favoured with several more volumes of the *Index Catalogue* (it is hardly necessary to add) *of the Library of the Surgeon General's Office, United States Army*. The last volume before us is said to include 4566 author titles, representing 2263 volumes and 3517 pamphlets; it also contains 4151 subject-titles of separate books and pamphlets and 22,977 titles of articles in periodicals. The library itself now contains 190,310 bound volumes, and 328,036 pamphlets. It is well to remind ourselves now and again of the great service to medical research all over the civilised world which such an index renders. The present volume is the twentieth of the second series and includes the letters V.—Water-works. A few examples of its comprehensiveness must suffice. Under Vaccination (History of) will be found references to the spread of Jenner's teaching in England, America, France, Spain, Germany, Denmark, and Sweden from 1801 to 1914. Vater's Ampulla gives 50 or more references to its particular cancer, and refers to the original Latin work of Abraham Vater [1684–1751] who christened it. Veronal (toxicology) gives the clue to fatal cases in all lands. Vitamines already have an extensive literature for the years 1913–14. We cannot be blamed for rejoicing in the adequate notice of Thomas Wakley in three generations. War (Pan-European) [1914] already has a place. Waters (Mineral) cover 90 pages, and include the literature of our own spas—Bath, Buxton, Cheltenham, &c., as well as a clinical grouping under radioactive, sulphurous, and so forth. No medical library is complete without this indispensable index, and its arrangement may well serve as a model for other works of reference.

[1] The passage is taken from an appreciation of S. Weir Mitchell, as man of letters, by Owen Wister, in Memorial Addresses and Resolutions, Philadelphia 1914.

[2] Edward Livingston Trudeau: An Appreciative Memorial. By Dr. S. A. Knopf. Journal of the American Medical Association, Jan. 22nd, 1916.

JOURNALS AND MAGAZINES.

American Journal of Roentgenology.—The official journal of the American Roentgen Ray Society is one of great interest to radiologists in this country; not only for the valuable nature of the contents, but as showing the modifications in technique and the aims of American radiologists. The Journal has recently been enlarged in that the contents of two or three numbers—as judged by former issues—are now comprised in one. The value of the issue is correspondingly enhanced.—In the November number Dr. Gregory Cole deals with the X ray diagnosis of indurated gastric ulcer; his method is that of serial radiography by which his name has been known for some time past. The one objection to this method is the very elaborate and powerful apparatus necessary, and the heavy expense attendant on its practice.—Dr. J. T. Case and Dr. Llewelyn L. Jones relate their experiences in the X ray treatment of the deeper parts. This paper is based upon observations during the use of the Coolidge X ray tube, which makes the administration of massive doses of very hard rays not only possible but easy. In reading this paper we are reminded of the desirability of some uniform method of dosage being adopted in all countries. The lack of it makes the correct appreciation of the practice of foreign writers a matter of some difficulty.—The X ray diagnosis of gall-stones seems to be making considerable headway in the United States, if one may so judge from a paper on the subject by Dr. E. W. Caldwell of New York. The writer, however, is not by any means so sure that this progress rests on any solid basis. He brings us back to the well-known fact that these concretions for the most part have a similar opacity to the soft tissues around them. Consequently no elaboration of technique will avail to show them on an X ray plate. On the other hand, faint markings occasionally appear on plates—owing to defects in manufacture or subsequent manipulation—that may easily be interpreted as gall-stones, which may or may not be present. The paper emphasises the fact that these stones cannot be demonstrated by X rays unless they contain some substance having a greater opacity than soft tissues, and in an appreciable amount.—Dr. H. Wessler, of the Mount Sinai Hospital, discusses the rôle of the X ray in the diagnosis of the obscurer forms of heart disease. This is a branch of X ray diagnosis that has not received the attention it deserves at the hands of British physicians, which is the more remarkable when we consider how easy it is to observe the heart and how readily alterations in its shape, size, position, and movement can be seen. A perusal of this paper would convince many that here lies a valuable field of investigation waiting to be opened up.—Dr. H. W. Van Allen gives some notes of the diagnosis of stomach conditions by the X ray method.

It will be observed that the November number is essentially clinical in character, but when we pass on to the next issue, December, 1915, we find that it is taken up almost entirely with the physics of radiology, and a very interesting and instructive number it is.—Mr. W. D. Coolidge gives an account of physical investigation work in progress on tubes and accessories, which is of surpassing interest and shows the enormous amount of painstaking research necessary to achieve any real progress. It also shows the lines along which future developments are being made, and will provide fresh material for the imagination.—Mr. A. W. Hull, in a rather abstruse paper, deals with Roentgen ray spectra, while Mr. J. S. Shearer discusses the factors governing photographic action of the Roentgen rays.—There are other articles in both numbers that are full of interest. One of the most valuable features of the Journal is the very full abstracts from all the important contributions to radiology in all parts of the world. They are prepared with no little skill and not emasculated by excessive brevity.

THE FOOD-SUPPLY OF THE GERMAN PEOPLE.

A YEAR ago[1] we reviewed at some length a pamphlet edited by Dr. Paul Eltzbacher, acting Rector of the Berlin High School, in which leading experts discussed the problems of the food-supply in Germany and the means to be taken for assuring it. As the war had hardly begun when the materials for the pamphlet were compiled, it was rather of the nature of a prophetic forecast than an embodiment of actual experience. It is of interest to see how this forecast was borne out by the experiences of the first ten months of the war as recorded in the pages of another pamphlet[2] by two of the most learned of the previous contributors, Professor Kuczynski and Professor Zuntz, both of Berlin.

The first chapter opens with a paragraph on "Our Position at the Outbreak of the War," which gives an interesting summary of the temporary breakdown of the plans which had so carefully been made. It bears the title—

The Food-Supply of the German People in the first Ten Months of the War.

"In time of peace our imports in foodstuffs had exceeded our exports by about one-tenth of the whole, and the same proportion held good in respect of fodder. On the outbreak of war imports ceased, and though the export of foodstuffs was at once forbidden, the result of this measure was not so favourable as it might have been owing to the difficulties, brought about by the war, in the bringing in of the harvest. By means of careful measures, such as forbidding the use of foodstuffs suitable for human consumption as fodder, any great hardship was avoided, but the supply of fodder which *in toto* contains about double the amount of nourishment present in foodstuffs for human consumption, was reduced owing to the cessation of imports and a meagre harvest by about one-fifth. A part of the deficiency of food and fodder could be supplied by greater thrift. To make up the remaining shortage a judicious reduction in the number of head of cattle was ordered, due care being taken that the number of horses, stock cattle, and milch cows should be reduced as little as possible. Unfortunately these measures were not carried out so thoroughly and energetically as they should have been, and the sufficient feeding of the population and of the indispensable cattle became jeopardised and even for the time impossible."

Cattle.

"The year 1913 was marked by a record harvest of grain and other kinds of fodder, and at the outbreak of war the condition of the cattle was unusually favourable. In 1914 the harvest was not so good, and had peace continued the condition of the cattle would probably have been correspondingly less satisfactory; but the outbreak of war caused an agricultural crisis and the decline in the condition of the cattle was thus enhanced. Unfortunately it was only here and there that the crisis was adequately dealt with, and in some places the slaughter of calves under 75 kg. in weight, and of cows under the age of 7 years (even in the case of bad milkers) was forbidden by law, and the slaughter of pigs discouraged; with the result that on Dec. 1st the number of pigs was greater by 33,926 than on June 2nd, and the number of cattle had also increased. In December and January there was as usual a decline in the number of pigs, and this was greater than the average owing to increased slaughtering and the less prolific breeding caused by the agricultural crisis. Meanwhile the Government had determined that more pigs must be slaughtered, and on Jan. 25th recommended all communes of more than 5000 inhabitants to buy up a great number of pigs. The price of pigs, however, rose to double that of peace-time, and the recommendation of the Government was only half-heartedly carried out. On April 15th a new census of pigs was taken, showing a drop since Dec. 1st of 35 per cent., and it seemed to the Government that the reduction had proceeded far enough. In the latter half of April and during May, however, the numbers began to rise again and by the end of May were probably as high as they had been in the middle of March. If the reduced number of pigs of the middle of April had been attained six months earlier and had remained fixed it would have made a vast difference in supplying the needs both of the population and of the indispensable cattle. As it was, great quantities of grain and potatoes were given to pigs and no very considerable gain in meat attained, while the other cattle suffered and particularly the horses, which already in February were on reduced rations of oats, though the harvest of 1914 would have been sufficient for their needs in spite of the unusually great demands of the war horses; and through this reckless usage the store of oats had by Dec. 1st been reduced by one-half. Several measures were then passed limiting the consumption of oats and confiscating all stores. Thus delay and wastefulness in the first six months of the war was followed by a shortage in the supplies of oats for the cavalry horses, and such reduced rations for the horses at home, particularly those employed in important agricultural work, as would materially injure their working capacity."

Cereals and Potatoes.

"After the harvest of 1914 our supplies of wheat and rye were so copious that in spite of the cessation of imports we could have consumed as much bread as in time of peace. On Oct. 28th, 1914, and Jan. 5th, 1915, the Bundesrat passed measures making it obligatory for first 72 per cent. and later 82 per cent. of rye and from 75 per cent. to 80 per cent. of wheat to be ground into flour. At the earlier date, in consideration of the fact that the harvest of 1914 had not been so good as that of the year before, the use of cereals as fodder ought to have been limited in order to ensure a sufficiency until the next harvest. But it was not till Nov. 4th that the unlimited use of cereals for feeding cattle was forbidden. This was not sufficient to put a stop to the mischief, and on Dec. 1st, after four months of war, it was found that the stores from the last harvest had been reduced by about one-half. If this rate of consumption had continued, Germany would have found herself by April entirely without wheat and rye. On the other hand, if on Dec. 1st the grain stores had been controlled by the Government it would have been possible to assure to the population 300 grammes of flour per head daily. But the Government contented itself with forbidding the use of cereals as fodder, and publishing official notices that whoever disregarded this prohibition would be guilty of a sin against the Fatherland, all of which was in vain, and in December and January greater quantities of rye and wheat were given to cattle than in peace time when no prohibition existed. It was not until Jan. 25th, 1915, that the Government took the supplies of wheat and rye into its own hands and decreed that those engaged in agriculture should have an allowance of 7·2 kg. of flour per month per head, and the rest of the population 225 grammes daily per head. Even these retrenchments were insufficient. In February only one-third of the grain store remained and the allowance of 225 grammes was reduced to 200. (In time of peace the average consumption per head is 340 grammes, so that the people had now to deny themselves 14 per cent. of their accustomed nourishment, and for the poor, with whom bread is a more important item, it was 25 per cent., or even higher)."

The great error, then, in the management of the cereal-supply was that the right solution had been found too late. When once the need was thoroughly realised the measures taken were excellent. That the flour rations at this time were not more generous was in the nature of a wise precaution; that the price of flour nevertheless remained so high may be attributed to the tardiness with which the Government had taken over the supplies of corn.

"Germany produces more potatoes than any other country in the world, but the crop of 1914 was below the average, and it was clear that in spite of curtailment of industrial

[1] THE LANCET, Feb. 20th, 1915, p. 389.

[2] Unsere bisherige und unsere künftige Ernährung im Kriege. Von R. Kuczynski, Direktor des Statist. Amtes der Stadt Berlin-Schöneberg, und N. Zuntz, Direktor des Tierphysiolog. Instituts des K. Landwirtsch. Hochschule, Berlin. (Freidr. Vieweg und Sohn, Braunschweig. 1915.)

consumption (alcohol, starch, &c.) 22 million tons must not be used for fodder as they had been in time of peace, for potatoes had to take the place of other foodstuffs that were lacking. For this purpose it was calculated that 20 million tons ought to be kept in reserve. To attain this end the 22 million tons which had formerly been used as fodder must be reduced to 12 million tons. Instead of this being done, during the first months of the war the use of potatoes as fodder actually increased and was even mistakenly encouraged by the Government—e.g., on Oct. 15th, when a recommendation was issued that in view of the unusually large potato crop and the deficiency in fodder, potatoes in every form should be used to replace imported fodder. A very low maximum price was fixed for potatoes, which encouraged waste and, as in the case of cereals, a serious depletion of the stores obliged the Government to change its policy. On Jan. 9th the Prussian Minister for Agriculture declared that owing to the increased use of potatoes for human consumption consequent on the lack of cereals and imported foodstuffs, the recommendation to a freer use of potatoes for fodder had not produced the desirable effects that had been anticipated. On Feb. 15th, in order to hinder the feeding of cattle on potatoes, the price of the latter was raised from M. 35 a ton to M. 85–96 a ton, and a few days later the Kaiser declared that the use of potatoes as fodder was forbidden. But the supplies had already been seriously depleted. People who in time of peace consumed on an average 550 grammes of potatoes daily now took considerably more both as vegetable and also mixed with flour in the bread, while owing to the lack of barley and maize pigs had been fed very largely on potatoes, and a great deal more than usual had been consumed by cattle and horses. Thoughtful people were urgently recommending the taking over of the potato supplies by the Government as had already been done with the cereals, and the Reichstag took the matter under consideration, first ascertaining what supplies remained in the country. The results of this inquiry were, however, not conclusive. The Government now realised the necessity of securing a supply of potatoes for the populations of the towns, though it was not yet prepared to take over the whole potato-supply, a measure which it declared impracticable owing to certain technical difficulties. It decided, however, to secure 2 million tons for the use of the poorer classes in towns, and appointed a 'Reichsstelle für Kartoffelbewirtschaftung' to deal with the matter. In buying, the maximum price holding good in any particular district would be paid, and in addition a sum—beginning at M. 20 and rising to M. 80—to cover storage, loss by rotting, &c. It was hoped that this additional tax would be an inducement to the farmers to sell and would hinder the use of potatoes as fodder. Unfortunately the farmers were not so willing to sell as was expected, and the Government was only able to obtain about a tenth part of the quantity it had resolved to buy. It was on April 12th that the 'Reichsstelle' came into force. It decided which supplies were to be given up directly to itself or to the communes, but where possible the supplies were to be acquired by a voluntary sale on the part of the farmers. The conditions of buying remained as before. Where supplies of potatoes within a district were insufficient for the needs of the population in that district the commune was to send an initial notice on May 1st to the 'Reichsstelle' and a final notice on May 20th, though in cases where the farmers refused to sell the communes were empowered to appropriate the supply. Even these measures failed to elicit the required quantity, and now the inevitable results of this dilatory and half-hearted legislation began to make themselves felt. Innumerable people had on the rising of prices suddenly taken to the potato business, and being unable to store the potatoes suitably, found themselves obliged to sell at a very low price. For example, prices sank by a third and more within a month in Berlin, just at the time of the year when a rise was usual. The communes thus made much smaller final demands on the stores so dearly acquired by the 'Reichsstelle' than their provisional demands of May 1st, while at the same time the military commissariat administration required only 17,600 tons instead of an estimated 200,000 tons, and the 'Reichsstelle' was left with a surplus. The ultimate result of the delay in securing supplies for the poorer classes was an ever-increasing potato famine and corresponding rise in prices. In this matter, again, had the Government in good time taken the control of the whole potato-supply into its own hands these evil consequences would have been avoided."

Standard of Living.

"For the first six months of the war the condition of the food-supply was not less favourable than in time of peace. Unemployment had indeed increased greatly, but the percentage of unemployed connected with the trades unions sank little by little from 22·4 at the end of August to 6·5 at the end of January, the latter being about double that in time of peace. At the same time food prices had risen steadily in spite of all efforts to prevent this, although in many trades wages had risen correspondingly. Later on, however, as the cereal supply began to run short and a bread ration was fixed the poorer classes lost about 20 per cent. to 25 per cent. of their staple diet. The price of rye bread in January, 1915, had risen 33 per cent., and in May 53 per cent., wheat bread 26 per cent. to 35 per cent., as compared with prices in January, 1914, and May, 1914. With other foods prices had risen on an average by 81 per cent. from May, 1914, to May, 1915. This is, however, misleading, in that certain foods—e.g., lentils, semolina, &c.—which had risen greatly in price since the outbreak of war, had been consumed in much greater quantities than in time of peace, so that, taking this into account, an average rise in prices of 52 per cent. may be estimated. This great rise in prices forced the mass of the people to buy the cheaper kinds of food and also to buy smaller quantities. A great deal of the difference was accounted for by more careful cooking and usage—e.g., cooking potatoes in their skins and so forth; but in such foods as meat, milk, &c., such a saving was not possible. Conditions were thus very grave for the working classes, more especially as potatoes and pulse, which might largely have taken the place of meat and bread, had become scarce and therefore expensive. Briefly, the situation from February or March onwards was one of enforced moderation with health-giving results to hundreds of thousands of over-fed people, but implying for the masses a weakening of their working capacity by hardship which amounted to actual want. A few months of such conditions might do no great harm, but their long continuance would threaten the country with grave danger."

We see, then, that where the distribution of staple articles of diet was regulated by the German Government, as in the case of cereals, the result was in agreement with the forecast, after an initial period of confusion and uncertainty. With potatoes, on the other hand, where no regulation was attempted until quite late in the winter months, disaster was only narrowly averted.

Further articles will deal with the regulation of the coming harvest, based on the experiences narrated.

LITERARY INTELLIGENCE.—The Cambridge University Press has undertaken the agency in Great Britain for two new medical journals: 1. *The Journal of Cancer Research* (quarterly), which will be the official organ of the American Association for Cancer Research. It will be the object of this journal to collect under one cover such contributions as bear in any way upon the general problems of oncology. It will therefore embrace studies which approach the subject from the individual standpoints of statistics, immunology, pathology, and inheritance. The first number will appear very shortly. 2. *The Journal of Immunology* (bi-monthly), which will be edited by Arthur F. Coca, of Cornell University Medical College, and will be the official organ of the American Association of Immunologists and the New York Society of Serology and Hæmatology. This journal will be published under the direction of an advisory board and an editorial board composed of American and English workers in this field. The subscription price for each journal will be 23*s.* net.—Messrs. J. and A. Churchill are to publish a book entitled "Surgery in War," by Major A. J. Hull, R.A.M.C., with a preface by Sir Alfred Keogh, K.C.B. Several contributors have assisted Major Hull in the compilation of the work, which is illustrated with X ray plates and diagrams.—A volume entitled "More Minor Horrors," by Dr. A. E. Shipley, is now in the press, and will be published by Messrs. Smith, Elder, and Co. in the early spring.—Messrs. Cassell and Co., Limited, announce for immediate publication a second and enlarged edition of "Diseases of the Nose and Throat," by Sir StClair Thomson.

THE LANCET.

LONDON: SATURDAY, FEBRUARY 26, 1916.

The Problems of Cerebro-spinal Fever.

THE outbreak of cerebro-spinal fever in several military training centres during the winter of 1914–15 created at once an urgent demand and a valuable opportunity for investigation of the outstanding problems of that disease. By coöperation between the War Office and the Medical Research Committee (National Insurance Commission) bacteriological stations were quickly established in the affected districts, and arrangements were made for the issue of appropriate culture medium by the staff of a central laboratory under Major (now Lieutenant-Colonel) M. H. GORDON at Millbank. When the epidemic declined in the summer months Professor F. W. ANDREWES, Professor W. BULLOCH, and Professor R. T. HEWLETT were invited by the Medical Research Committee to form an Advisory Committee for the purpose of sifting and summarising all the experience gained in these scattered bacteriological stations, "both for their application in the administrative control of the disease upon the next occasion, and for the guidance of the directions of future research." The fact that this step was taken is of itself noteworthy. Too often in this country valuable researches have been lost to sight, only to be done all over again in later years, by just the lack of a central body, such as the Medical Research Committee, concerned with the coördination of work and the due registration of progress.

The report which the Advisory Committee has drawn up in the present instance is one of exceptional interest and value. It concerns itself chiefly with bacteriological and epidemiological questions. At the outset the authors insist that there is no need to look beyond the meningococcus (*Diplococcus intracellularis meningitidis*) for the essential cause of the disease; nor any warrant from facts for seeking, as some recent writers have done, to invoke the obscure phenomena of "pleomorphism" in explanation of any anomalous features. As the report proceeds it is apparent that the work already done is making headway towards the understanding of the disease, and that further researches may be conducted most profitably along a similar course. A large part of last year's work consisted in the detection of carriers of the meningococcus by cultivation from throat swabs. This was work in which but few of the bacteriologists concerned had previously had a large experience. It was, moreover, beset with difficulties, one of which in particular was the difficulty of differentiating between meningococcus, and certain of the chromogenic group of cocci (Micrococcus flavus and others) which closely resemble it, and are occasionally to be found in the naso-pharynx. In some quarters doubt was expressed as to whether any strict differentiation was possible with the criteria we at present possess. The Committee's ruling upon this matter is important and reassuring. They acknowledge the possibility that the boundaries of bacterial species may require to be readjusted in the future, but they are clearly of the view that "a given coccus from the naso-pharynx *can* be identified as the meningococcus, or not the meningococcus as the case may be, with a certainty comparable to that accepted in other bacteriological or biological questions, provided that those tests be employed which experience has shown to be satisfactory." Unhappily the tests in question cannot, or at least could not last year, be completed in less than five or six days, and it must have frequently happened that carriers were multiplied during this period by the herding together of the contacts of a meningitis case until the result of their throat swabs was declared. The report gives ground for hoping that this period of testing may be considerably shortened, and the recognition of the meningococcus at the same time made still more sure by the use of serum tests. In the past most workers have found these tests "capricious and unreliable" in dealing with the meningococcus, and they have not therefore come into general use, but the whole question has now been put upon a more satisfactory footing by the laborious investigations of Colonel GORDON and his fellow workers at Millbank. Their work has shown, as was foreshadowed some years ago by ARKWRIGHT and others, that the conception of the meningococcus as a bacterial species of which all the members are identical, must give place to the recognition of a meningococcus group, including several types or races, just as has been shown in connexion with the Gärtner group of bacilli, and more recently in connexion with the pneumococcus. Two of these types of meningococci (I. and II. of Colonel GORDON'S records) were found to be responsible for the large majority of cases of cerebro-spinal fever last year, and the same two types have also been identified in several of the cases which have occurred during the present winter. The further progress of this research may be expected to show how many of the meningococci found in carriers belong to these known dangerous types and how many to other types possibly harmless. To this end monovalent rabbit sera have now been prepared by Captain T. G. M. HINE at Millbank which, it is hoped, will serve to "place" a large proportion of such strains as may be obtained during the present spring, both from carriers and from the cerebro-spinal fluid. These sera will be issued from the central laboratory as occasion may arise, and, in addition to their value in throwing light on the prevalence of the different types of cocci, it seems legitimate to hope that their use will also shorten by some two or three days the period of delay in detecting positive contacts.

Perhaps the most interesting feature of the report is the new point of view which the Committee takes up, tentatively as yet, with regard to the origin of carriers. Hitherto the carrier condition has usually been attributed to contact with a victim of cerebro-spinal fever, but now it is suggested as probable that a large proportion of the carriers found in any group of contacts "were not infected from the case of cerebro-spinal fever, but represented the proportion of carriers already present amongst the population where the case had arisen." The same idea appears in the Committee's summing up. "The epidemic," they suggest, "is not one of cerebro-spinal fever as such, but what may be termed a 'saprophytic epidemic' of the meningococcus in the throats of the population at large, governed as to its local incidence by the opportunities afforded for transfer of the coccus from pharynx to pharynx. It is an epidemic prevailing in winter and early spring because climatic conditions bring people into closer contact indoors at that season; it dies out in summer for the converse reason." This hypothesis should be read in conjunction with the recent work just mentioned on the several types or races of the meningococcus, some of which are more dangerous than others. It is suggested that in any given epidemic there may occur a saprophytic spread of both the dangerous and the comparatively harmless strains "so that there are carriers of either, undistinguishable except by serological means." Along these lines there might well be found an explanation for the notorious fact that very few carriers of the meningococcus contract cerebro-spinal fever. At present, however, these conceptions must be regarded as constituting only a working hypothesis. To establish or refute it there is need of (*a*) a virulence test; (*b*) a carefully planned "carrier census" by bacteriological investigation of large samples of all sections of the population, both in epidemic and non-epidemic years, and at different seasons of those years. A beginning of this work has already been made by the Local Government Board, and striking figures are contributed to the present report by Dr. A. EASTWOOD, Dr. F. GRIFFITH, and Dr. W. M. L. SCOTT. Of 480 patients examined at St. Bartholomew's Hospital who had no knowledge of any contact with a case of cerebro-spinal fever no less than 10·2 per cent. were found to harbour meningococci in the naso-pharynx. This was in the spring and early summer of 1915. Again, examination of 138 non-contacts among the out-patients of Lambeth Infirmary showed 13·7 per cent. to be carriers. From an analysis of these and other data included in the report it appears very probable that a notable falling off in the percentage of carriers occurred as the epidemic declined last year, a circumstance which also squares with the working hypothesis of the Committee, but judgment on these matters must be reserved until a much more complete "census" is available. If that confirms the hypothesis of a "saprophytic epidemic" the administrative control of cerebro-spinal fever would appear to turn upon the possibility of limiting opportunities for the transfer of the coccus from pharynx to pharynx among the population—no easy matter, we anticipate. Some instructive experiments bearing upon this transfer of the microbe are reported from St. Mary's Hospital. It was found that no meningococci grew on plates held directly under the nostrils of a carrier breathing heavily for some minutes, but explosive expiration gave positive results; sneezing on to a plate gave many colonies, and two out of five carriers who coughed on to a plate, held vertically about a foot away, gave one or more colonies. On five occasions plates were exposed in sitting- and sleeping-rooms used by a group of seven carriers, on tables where they were writing, or at the head of a bed; only once were one or two colonies of meningococci found. From these observations it was concluded that the organism is not easily dislodged from the naso-pharynx, and that carriers would be little liable to convey infection if they always took the precaution of coughing and sneezing into a handkerchief, or into a piece of rag which could be burned. The danger of transfer by saliva is probably slight, as the streptococci which abound in that secretion are strongly inimical to the meningococcus, and that microbe is also very intolerant of drying. It is worth noting that two observers engaged in swabbing carriers almost daily, without wearing masks, became infected themselves within a fortnight.

The pathology and treatment of cerebro-spinal meningitis are only touched upon in the report in so far as they are connected with bacteriology or immunity. We are still in the dark as to how the meningococcus reaches the meninges from the naso-pharynx—whether by the blood stream or by some direct channel through the base of the skull. To help towards the settlement of this question the Committee urge that blood cultures should be more commonly practised in the early stages of the fever. They recall the great service which this procedure has rendered in clearing up the pathology of typhoid fever and acute pneumonia. In respect of treatment the experience drawn upon in the report is disappointing. Little or nothing appears to have been learned as to the value of specific serum, probably for the reason that all sorts of sera were employed, and usually without any evidence that they were capable of a specific effect upon the strain of meningococcus by which the patient was infected. The Committee express the hope, however, that recognition of the dangerous types of meningococci in any future epidemic will allow the appropriate *homologous* sera to be employed, and that the serum treatment of this disease will then have a better chance to prove its value than it has yet had in this country. Vaccines have been employed during the fever in several centres on small series of cases, and with varying results. There is no mention of cases treated by the combined plan of active immunisation by vaccine and intrathecal attack by specific serum.

The Present Position of Midwives.

A CORRESPONDENT, who has had five years' experience as an inspector of midwives, calls attention in a letter to the present position of the midwife in this country. He suggests that there is an actual shortage of women in practice as midwives, and that this creates an anxious situation in view of the steady depletion of the medical men and the increased responsibility thus thrown upon these women. The experience of the Central Midwives Board is that there is no shortage in the total supply of midwives, but, in fact, a steady increase in the numbers on the Midwives Roll. The total number of names removed from the Roll in the year ending March 31st, 1915, by reason of death, voluntary resignation, or penal proceeding, was 505, whilst the number placed on the Roll after successfully passing the Board's examination was 2086, of whom 918, or 44 per cent., declared their intention of practising as midwives. The difficulty is therefore not one of supply, but of the proper distribution of the supply. As might be guessed, there is no shortage of midwives in towns. In the sparsely populated country districts, on the other hand, it is impossible for a midwife to earn her living unless she is employed and paid by a nursing association or by a private employer. The county councils as a whole have done, and are doing, much to remedy this difficulty, but there are still some counties, particularly in Wales, where the matter has not been taken up with energy. It must be remembered that the midwives available are not all of the same class or capacity, though the material is improving every year. As the old midwives, or what is termed the *bonâ-fide* class, gradually die off they are being replaced by trained women, and, while this change in itself is welcome, it is at the same time the chief cause of any shortage that there may be in the remote rural districts. The old class of midwife was almost invariably a married woman, and generally combined other duties with the practice of midwifery. She was therefore not subject to the financial difficulty of the trained woman who practises midwifery only. What is needed is some arrangement by which rural districts can count on the services of the trained midwife, and this could be made possible by provision of the means of transport so that she could cover a sufficient area to make her practice self-supporting. An alternative arrangement, and one involving less mechanism to set up and less strain for the midwife herself, would be the combination in one woman of the functions of district nurse and midwife, when her work would become remunerative. To some such economical combination those who know the practical difficulties of the existing situation are looking for relief.

Various agencies are at work to raise the status of the midwife. From July next a new regulation comes into force that no person shall be admitted to an examination of the Central Midwives Board unless she has undergone a course of training in midwifery extending over a period of not less than six months. Only in cases where the examinee has had three years' previous nursing training will this period be reduced to four months. Thus the training period for a midwife has been doubled, and this change has, we understand, not been opposed by any of the training schools concerned. The midwife is, at all events, herself alive to the value of longer training. Another effort in the same direction is seen in the memorial which has just been presented to the Local Government Board by the Incorporated Midwives Institute and its affiliated institutions representing practising midwives in all parts of England and Wales. This memorial records the desire of the certified midwife to take her proper share in the endeavour to prevent those conditions that lead to the ill-health of the mother and the death or disablement of the infant; and stress is laid on the need for centres to which the mothers could be sent for adequate medical treatment in order to render ante-natal supervision effective. It is here claimed for the midwife that she should be recognised by the health officials as a proper person, where a medical man is not employed, to answer inquiries as to the health of the mother and the baby, and that she can, moreover, supervise the home conditions of her charges, and on receiving instructions can see that they are carried out. Certainly she could help to persuade the parents that the baby should be watched up to school age. In this way continuity of inspection without overlapping, friction, or waste of public funds should be secured. And thus, the memorial suggests, the midwife would no longer be a somewhat wasted factor in the general health scheme.

The memorial appears to formulate views whose recognition would raise the status of the midwife and produce what may be termed a virtuous circle, leading to a good class of applicants for the posts, so that a good class of work would be done. More inducements would be provided for the midwife to practise her profession. This is at the present moment an important matter. Are the conditions of the midwife's practice such as to attract the right class of woman into the calling? Our correspondent states that the midwife leads an arduous and harrowing existence. This is a necessary accompaniment of the career which she has chosen, and the prospect of hard work and anxiety should certainly not deter women from volunteering for public service. But the feeling that they may not always receive fair play has a bad influence. The practice of "covering" uncertificated women by medical men, to the detriment of properly certificated midwives, is very reprehensible. This still prevails in some country districts, and the evil is difficult to deal with, but both the General Medical Council and the Central Midwives Board share the desire to put a stop to this practice, one example of which has

been inquired into by the former body. Cases also have been reported to the Central Midwives Board in which medical practitioners have notified the local midwives that they will attend cases in which they are summoned on the advice of a midwife only if the midwife guarantees the payment of a fee of two guineas. In some cases, though not in all, this demand is ridiculous, and leads to the impression that the practitioners in question wish to render the midwives' work difficult, a course which can only deter the better class of women from becoming midwives. These things are all very unfortunate, but they are of local and infrequent occurrence and will tend, we believe, to disappear. They have been kept alive by the knowledge that the certified midwives have in some places usurped the functions of qualified medical men.

A Year's Record of Atmospheric Pollution.

WE publish this week in a special supplement the first report of the Committee for the Investigation of Atmospheric Pollution, and we think a careful perusal of this report will show that the new organisation is not only attacking a problem of the greatest importance to the public health, but that it has begun its task with commendable thoroughness and energy. The movement to which we owe this report has steadily progressed since its inception, which occurred practically in connexion with the Smoke Abatement Exhibition held in London in 1912 at the instance of the recently founded Coal Smoke Abatement Society. Simultaneously THE LANCET published the results of a year's practical work on the subject which admittedly gave an impetus to the campaign. This inquiry, however, was confined to the qualitative and quantitative examination of the sootfall of three stations only in the metropolitan area, and for the sake of comparison of a station a few miles out situated in the county of Surrey. The gauges employed were set up under the auspices of the Coal Smoke Abatement Society, and the deposits collected were analysed in THE LANCET Laboratory. The publication of these results created a very general interest in the subject throughout the country. To a member of our own profession, Dr. H. A. DESVŒUX, belongs the chief credit of founding the Coal Smoke Abatement Society, his efforts being forcefully seconded by the first chairman of the society, Sir WILLIAM RICHMOND, R.A. In this pioneer work they were fortunate in receiving the able assistance of Dr. J. S. OWENS, who possesses both medical and engineering qualifications, and the equipment and energy necessary for success in either calling. Subsequently a Committee was formed with Sir NAPIER SHAW, the Director of the Meteorological Office, as its chairman. Returns were sent in from the various stations, 39 in all, every month, and the results were embodied in a table under the heading of "A Monthly Record of Atmospheric Pollution," published regularly and exclusively in these columns, the first report appearing in THE LANCET of Oct. 24th, 1914.

In the drawing up of this, the annual report, which deals with the results of the first year's observations, Sir NAPIER SHAW has lent invaluable assistance towards systematising the results, which are of the greatest interest. They testify to the energy and ability of the organisers and of those who undertook the practical scientific work. The report enables the reader to make an effective comparison of the different stations at a glance. The numerical results for each element are arranged in four groups or classes. Units and limits are thus set out for the various constituents of atmospheric pollution, amongst the most important of which are tar, carbonaceous matter, mineral matter, volatile matter, sulphates, chlorine, and ammonia. The groups A, B, C, and D in the report represent progressive degrees of pollution in the air. Details will be found in the numerous tables published, and the amount of work involved in drawing them up has been very great. We may here indicate the value of the comparison which these tables enable us to make between different localities in regard to the extent of pollution taking place. In Manchester, for example, the School of Technology, with six months' record, gives the same results as the University not far away with only one month's record. Two other districts in Manchester give nearly similar results, but one gets the better mark for tar, while in another instance the soluble constituents and acids are increased. Yet another district in Manchester gives an exemplary record, only to be beaten by Malvern, in the matter of acid. Birmingham Central is almost identical with Sheffield, but Birmingham has more sulphuric acid in its air and Sheffield much more chlorine. Birmingham, London (one district), Cheadle, Leith, and York run entirely together with a succession of B's, until the ammonium column is reached, when Birmingham takes an A, London and Cheadle a B, Leith a C, and York a D. Exeter and Fallowfield (Manchester) would go with these, but the first gets an A for tar as well as for ammonia. Coatbridge would also present a uniform set of B's but for the striking absence of chlorine. The comparatively large figures for soluble ash indicated by the C's of the London and Manchester and Sheffield stations with Bolton, Newcastle, and Oldham are striking as compared with the B's for Birmingham and Scottish stations. Malvern is obviously conspicuous by its row of A's, and Bolton, Ancoats, and Oldham by their D's. These are but samples of the interesting comparisons made in the report. We may add as illustrating the instructive character of the results that, in the estimation of total solids, the lowest figure next to Malvern is Bowdon (Manchester), with 5·69 tons, and the next Birmingham, S.W., with 6·04 tons, both of which are in class B. Twenty-two stations get between 5 and 15 metric

tons per square kilometre per month, and 14 between 15 and 25 tons. A very interesting point about these figures is the differences shown by the stations in the same district, which, of course, means that there are local influences at work producing pollution.

The report contains a complete account of the machinery by which the results are obtained, and a series of maps indicating the localities of the collecting stations. It should be received with the greatest interest by public health authorities, as well as by those concerned in the preservation of property and public buildings. When we consider what enormous quantities of destructive solid and vaporous smoke products are emitted from chimneys and factory shafts to be scattered broadcast in the air, we must realise that an immense amount of harm to health and to property is steadily taking place from this cause. We may take it that the extent of this damage will vary directly with the proportion of pollution, and this is clearly disclosed in actual quantitative terms in the report. There is thus afforded by this document direct proof of the need for reform which should not fail to appeal to Parliament. A system of control is required to provide us just as much with an unsullied air to breathe as an unsullied water to drink and unsullied food to eat. All three are equal essentials. We congratulate the Committee for the Investigation of Atmospheric Pollution upon its first report, and we should like to see increased, before the next report is issued, the number of public health authorities gathered under its banner.

Annotations.

"Ne quid nimis."

HOSPITALS AND THE SPIRIT DUTIES.

THE conditions under which duty-free spirit might be supplied to hospitals are to be considered by a Departmental Committee appointed by the Treasury. It is suggested that the grant shall be fixed by reference to (1) a fixed standard consumption per patient based on the actual consumption in a standard year previous to the appointment of this subcommittee; (2) the rate of duty on spirit current during the year in respect of which the grant is made; and (3) the number of patients treated in the year, also in respect of which the grant is made. The difficulty experienced in defining a hospital appears to have been overcome by providing "that the institutions to participate in the grant shall not include any institutions carried on for purposes of gain." The misgivings expressed as to the possibility of abuse arising out of the grant do not appear to be well founded. At all events, the supply can be regulated with the greatest ease, and this would rule out any question of unlimited use. The revenue authorities could regulate the supply as they do in the granting of absolute alcohol for research purposes, allowing only a certain amount per annum and a certain amount of stock to be kept at any one moment. Apart from the use of alcohol solely for medical and surgical purposes, the restrictions placed upon its employment for industrial objects will have to be relaxed if our home chemical manufactures are to compete successfully with foreign productions. It is difficult to understand why the use of alcohol in industries can be permitted without imposition and risk of abuse on the continent, while the same freedom cannot obtain in this country. The difficulty would be met, of course, by the creation of a properly organised system of control and supply.

THE SALE OF NARCOTIC DRUGS TO SOLDIERS.

ALTHOUGH most of the sensational stories concerning the growth of the drug habit in the army can safely be discounted, it is evident from recent revelations in police courts, both in London and the provinces, that there is a considerable demand among soldiers, both officers and men, for morphine and cocaine. Almost simultaneously with the Folkestone case, in which two persons were sentenced to imprisonment for supplying cocaine to privates in a Canadian regiment—and in the course of the hearing of which it was stated by an officer of the Royal Army Medical Corps that there were 40 men in a barracks hospital suffering from the cocaine habit—proceedings were instituted by the Pharmaceutical Society against two London firms for selling morphine without observing the restrictions imposed by the Pharmacy Acts. The Folkestone case, on the one hand, revealed an underhand practice systematically carried on for the purpose of making profit out of the demoralisation of men who had come across the seas to fight for their mother country; the London cases, on the other hand, gave publicity to the fact that a traffic has been carried on in morphine, prepared in an insidious form. But what it is still more important to observe is that this sale of morphine is being conducted in a manner which is perfectly lawful, for the incidents which brought the two firms to the police court were obviously isolated cases of inadvertence. In one case, in fact, it was pleaded in mitigation of the offence that the demand for "lamels" of morphine by officers is so large that the supply was not kept in the poisons department with other potent drugs, but was stored in a handy place so that officers would not be kept waiting. So long as the officer who buys these things is known or introduced to the chemist who sells them, the poison book is signed, and the package properly labelled, all the requirements of the law are fulfilled and the traffic can go on from one year's end to the other until every officer and every man in His Majesty's Forces has his pocket-case regularly supplied with palatable little gelatine discs of morphine. Clearly this state of affairs is against the interests of the army and against the interests of the State, and it is equally clear that the provisions of the Pharmacy Acts are totally inadequate to prevent soldiers from obtaining narcotic drugs. In the Folkestone case the authorities had to utilise the elastic provisions of the Defence of the Realm Act to punish the offending sellers, and if it is found that the publicity given to the proceedings in London fails to convince the statutory vendors of poisons that it is a thoughtless and unpatriotic thing to supply habit-forming drugs to soldiers ignorant in medical matters, the authorities may promulgate an Order making it an offence for chemists to sell morphine or cocaine to persons they know to be soldiers, and an offence for soldiers—except, of course,

officers of the Royal Army Medical Corps—to attempt to procure the drugs. In nearly every other civilised country these poisons can only be sold, even in peace time, on the written order of a medical practitioner, and if similar legislation were embodied in an emergency order in this country, at any rate for the period of the war, it is difficult to see what hardships would be involved, but easy to realise the benefits that would result.

THE BACTERICIDAL ACTION OF BLOOD ON PARATYPHOID BACILLI A AND B.

Mr. K. Sakagami has continued his work[1] on the bactericidal action of the blood fluids in the inoculation department of St. Mary's Hospital. Using the "wave-wash" technique of Sir Almroth Wright[2] he has obtained results which indicate (1) that normal blood serum has a certain bactericidal action on paratyphoid bacilli A and B, but this is less than on typhoid bacilli; (2) that this bactericidal action is more marked in the case of B than A; (3) that the serum is more potent than the blood as a whole or than the corpuscles separately unless the latter are shaken and centrifuged; and (4) that some bactericidal action was exerted by the serum of those inoculated with paratyphoid vaccine. These careful observations may form a basis for further work in this direction.

A NEW METHOD OF EXTRACTING BULLETS.

MANY methods of removing bullets and other metallic projectiles from the tissues have been invented, and some of them have proved in practice extremely ingenious and useful. The latest method has been invented by Captain A. E. Barclay, R.A.M.C.(T.), who demonstrated the use of his instrument recently at a meeting of the Electro-Therapeutic Section of the Royal Society of Medicine. Captain Barclay pointed out that in most methods of localisation a very slight alteration through movement was sufficient to neutralise the information obtained from the X rays, when the bullet might not be found. He held it to be necessary that when the position of the bullet had been ascertained, it should be kept under observation on the fluorescent screen until it had been removed. In his method the position of the bullet was first determined by means of a screen, and this position was marked by means of an aniline pencil on the skin. Then the pair of forceps he had devised is taken; it bears a small fluorescent screen so that the surgeon can keep the bullet in sight during the whole time of the extraction. The forceps are so shaped that the handles are at a right angle with the blades, and therefore do not obtrude on the line of vision. One blade is longer than the other and is hollowed so that the other blade can rest in it when the forceps are closed. Each blade is connected with an electric current so that when a metallic body is seized by the blades a bell rings, but by means of a small piece of insulating substance no electric contact is effected when the blades are closed. A small incision is then made through the skin, through the marked spot of a length of an inch or a little more, and the forceps are passed through the opening and are directed towards the bullet, guided by the view in the small screen. When the longer blade touches the bullet the blades are separated and the bullet is grasped between the blades, and then the bell rings. The whole instrument, including the screen, is sterilisible. At the demonstration several bullets were extracted very expeditiously from a loaf in which they had been embedded. The method has been employed by Captain Barclay in some dozen cases, and in every case the bullet was removed easily, except in two where the wound was of old-standing and the bullet had become surrounded by a mass of fibrous tissue; but he explained that if this instrument were employed early there would be no risk of the formation of this fibrous tissue. These forceps have also been employed for the removal of needles. The method appears to us to be extremely ingenious and practical, and well deserving of an extensive trial. One great merit which it possesses is that a bullet can be removed from a great depth through a very small incision in the skin.

[1] THE LANCET, Jan. 15th, 1916, p. 127.
[2] Wound Infections and their Treatment, THE LANCET, Oct. 30th, 1915, p. 950.

STROPHANTHIN IN EXPERIMENTAL PNEUMONIA.

WHEN pneumonia comparable in many ways to that which occurs in man has been experimentally produced in animals opportunity can be taken to observe the effect of drugs of the digitalis type. For this purpose Dr. Ross Jamieson, who reports his findings in the *Journal of Experimental Medicine* (1915, vol. xxii., p. 629), used cats and dogs. In both pneumonia was induced, and at the height of the disease, about the second or third day, the normal lethal dose of strophanthin was run into the veins, this process lasting one hour. The results were compared with a similar procedure applied to normal animals, and to pneumonia animals without drug administration. The effects upon the heart were noted by means of the electrocardiograph in each of the three groups. It was found that the death-rate was much the same whether or not the strophanthin had been given. And it was further shown that the form of the electrocardiographic curves was similar in all groups. There was some lengthening of conduction-time between auricular and ventricular systoles, extrasystoles became frequent, and, when death ensued, ventricular fibrillation occurred. Such findings appear to lend experimental support to the clinical observations of Mackenzie that he had seen no noticeable effect from these digitalis drugs in pneumonia.

DEATHS AT THE ZOO.

THE report on the deaths which occurred at the Zoological Gardens, London, during 1915 by the pathologist to the Zoological Society, Professor H. G. Plimmer, F.R.S., makes interesting reading. The total incidence of fatal microbic and parasitic disease for 1915 was 7·8 per cent. for mammals and reptiles, and 5·3 per cent. for birds. But the larger proportion of these deaths occurred in animals which had not been six months in the Gardens and were not acclimatised. Excluding these the percentage of fatal microbic and parasitic disease was just under 1 for mammals and birds, and just over 1 for reptiles. The deaths from tuberculosis have never been so few since accurate records were kept at the Gardens. Only 6 (= 0·5 per cent.) mammals, 60 (= 1·8 per cent.) birds, and 2 (= 0·3 per cent.) reptiles died from this cause. Three ungulates died from tubercle of human type which Professor Plimmer attributed to the spitting of visitors to the Gardens, a very common bad habit there. The two monkeys—a cercopitheque and a baboon -which

died were pet animals, and neither were allowed out of quarantine. Of the 274 mammals which died from diseases other than tuberculosis, no evidence of tubercle was found in the body. There seems, therefore, to be an almost complete absence of endemic tubercle among the mammalian population of the Gardens, a fact on which the Society may well congratulate itself. The reduction of deaths from this cause among the birds amounts to nearly 50 per cent., and Professor Plimmer looks to a further improvement if the population of many of the bird-houses can be reduced. Two animals—a flamingo and crocodile—were the first recorded in their species to die from tubercle. Of other microbic diseases, mycosis and pneumonia, with 48 and 152 deaths respectively, account for most of the remainder. In mammals pneumonia was sometimes associated with pyorrhœa and rickets. Of non-microbic diseases the three groups of (1) bronchitis, broncho-pneumonia, and congestion of the lungs with 198 deaths, (2) enteritis with 183 deaths, and (3) nephritis with 127 deaths were prominent, and in all there was a relative decrease. The inflammatory affections of the alimentary tract were apparently due in a large majority of the cases to the quality or quantity of the food not being suitable to the animal. Nephritis considerably decreased as a cause of death; only 31 of the cases were acute, the remainder being associated with other senile changes. Old age, or the artificial old age induced by captivity, accounted for about 100 of the total deaths. The report concludes with a list of blood parasites which have been found, and Professor Plimmer states that the blood of every animal which died had been examined. The parasites found, many of them for the first time, were as follows, the number of animals in which they occurred being added in brackets: Filariæ (9), trypanosomes (2), malaria (9), leucocytozoa (3), toxoplasma (1), hæmogregarines (17), and intestinal organisms (5). The report is a record of accurate work and throws valuable light on the diseases of wild animals in captivity. A nervous public will welcome the information that endemic tubercle is nearly extinct in the Zoological Gardens.

GAUCHER'S DISEASE.

AN instructive résumé of this condition, characterised more particularly by the great splenic enlargement, is given, together with reports of two cases occurring in infancy, in the current number of the *Bulletin of the Johns Hopkins Hospital* (1916), by Dr. M. Knox, Dr. H. R. Wahl, and Dr. H. C. Schmeisser. Gaucher first drew attention to this small group of splenomegalies in 1882. Since then only 16 cases have been reported, though it is suggested that this number will be much increased with more thorough microscopical investigation of the organs mainly involved. The characteristic feature of Gaucher's disease is the presence in the enlarged spleen of special large "Gaucher" cells. They are pale in colour, large in size, about 20–40 microns, and possess one or more relatively small nuclei. What is suggestive is that these cells may be found, not only in the spleen, but also in the liver, the lymph glands, and even the bone-marrow. The cells are predominantly fatty or lipoid in composition. These general facts lend weight to the theory advanced that Gaucher's disease, despite the typically enlarged spleen, cannot be considered as a primary splenic condition, but rather that this organ, together with others, is involved in a generalised process due to a disturbance in fat metabolism; there is a "lipoid metamorphosis." What the cause of this disease is remains a matter of conjecture. As regards the clinical course of Gaucher's disease, it occurs at any age, but usually in young adults. The symptoms are insidious, and enlargement of the abdomen is often the first complaint. Hæmorrhages may appear. Examination reveals much splenic enlargement, the organ preserving, however, its shape and consistence. The liver was also enlarged in 14 out of the total 16 cases and the lymph glands in 10. The blood shows an ordinary secondary anæmia count with, however, a leucopenia. The course of the disease is usually measurable in years, and splenectomy has, in the few instances in which it has been performed, failed to arrest the course of the disease.

WOMEN NURSES IN THE MEN'S WARDS OF MENTAL HOSPITALS.

IN a paper read at the general meeting of the Medico-Psychological Association on Feb. 17th Dr. G. M. Robertson vigorously upheld views already expressed by him in favour of the employment of women rather than men as nurses for the male insane. This he described as a characteristic and firmly established feature of the modern system as practised in Scottish asylums, but the experiment, if it has hitherto been made more or less exclusively in the north, is now likely to be extended, and may become universal through force of circumstances. The war has created a serious shortage of male attendants in asylums, suitable men disqualified for enlistment are not to be found in sufficient numbers to replace them, and, as in many other spheres of industry, women now gain the opportunity for demonstrating their power, or their incapacity, to take places hitherto assigned with little or no question to men. Dr. Robertson, in an interesting exposition of the case for women as attendants or nurses of male insane patients, traces the history of their employment before the existence of the present necessity for its extension. An early and almost accidental trial of women was made by Dr. Samuel Hitch in Gloucester General Lunatic Asylum in 1841, when he caused the wives of some of his married attendants to help their husbands in the male wards, induced to do so by observation of the harsh methods employed by the men, and his lead was followed in many English asylums during the next 40 years. Dr. R. M. Bucke in 1883 successfully employed widows of good character in the men's wards of the London Asylum in Canada, and Sir Thomas Clouston, who had placed a married couple in charge of the Male Hospital at Morningside, continued the widow in sole charge, with male and female attendants under her, when her husband died in 1890. These were steps in the development of what Dr. Robertson designates as "auxiliary female care," as distinguished by him from "entire female nursing," first made use of in Fife and Kinross Asylum in 1896 by Dr. A. R. Turnbull, who placed a ward of 30 male patients entirely under women by day. In 1900 Dr. Robertson himself handed over the care of a group of male patients exclusively to women by night and day at the Stirling District Asylum, and his example has been followed in other asylums in Scotland. It is this "entire female nursing" that he advocates without reserve or hesitation for all purposes and occasions for which it is practicable, and he upholds

its superiority over mere "auxiliary female care" as preferable for the nurses and more beneficial to their patients. Judged apart from abnormal and temporary conditions imposed by the war, the employment of women nurses for men in lunatic asylums or mental hospitals is a natural accompaniment of the development of the latter from the former, and would appear to be reasonable and commendable in principle if found successful in practice. The "hospitalisation" of the asylum, to use a word which Dr. Robertson has found convenient, is a movement now being effected amid general medical approval, and is not likely to be arrested in any way by a war which is sending home in hundreds soldiers in need of mental treatment. Sympathy with them will go a long way to encourage in the public mind the tenet that mental derangement is a disease requiring the care of the physician, and valuable public support will be won for the hospitalised asylum, which, of course, has long ceased to be the prison for dangerous beings of less than a century ago. In the newer institution Dr. Robertson claims for women, duly trained as nurses for the insane, the opportunity for displaying that superiority in nursing of which the community seeks to take advantage in general hospitals, and which he ascribes to the exercise of "mothering instinct." To this instinct no doubt we must turn in part in order to find an explanation of a power to exercise "more control over cases of mania than male attendants, a control based on persuasion and not at all on the show of force or on compulsion." At any rate, in his advocacy of women nurses for insane male patients Dr. Robertson makes appeal to actual experience, and it is upon observation of his facts that any difference in opinion from him must be based.

THE Morison lectures on the Neurology of the War will be delivered by Dr. Edwin Bramwell in the hall of the Royal College of Physicians, Queen-street, Edinburgh, on March 6th and 10th, at 5 P.M.

Colonel Sir John Rose Bradford, K.C.M.G., C.B., A.M.S., has been elected President of the London and Counties Medical Protection Society, Limited, in place of the late Dr. George Allan Heron.

Professor Weinberg, head of the laboratory of the Pasteur Institute in Paris, will give the Dr. James Finlayson lecture in the Faculty Hall, 242, St. Vincent-street, Glasgow, on Tuesday next, Feb. 29th, at 4.30 P.M. The lecture will be on Gas Gangrene, and all medical practitioners are invited to attend.

THE death is announced from Courmayeur of Pietro Grocco, senator and professor of medicine in the University of Florence, at the age of 59 years.

THE address of the Medical Research Committee has been changed to 15, Buckingham-street, Strand, W.C.

DONATIONS AND BEQUESTS.—Among other bequests the Right Hon. Arnold Morley, of Stratton-street, Piccadilly, W., has left £2500 each to the General Hospital, Nottingham, the Convalescent Homes Association, Nottingham, and the Children's Hospital, Nottingham; £1000 to the Women's Hospital, Nottingham; and £500 to the Anglo-American Hospital, Cairo.

CENTRAL MIDWIVES BOARD.

A MEETING of the Central Midwives Board was held at Caxton House, Westminster, on Feb. 17th, with Sir Francis H. Champneys in the chair.

A letter was considered from the town clerk of Rotherham stating that the town council of Rotherham is of opinion that action should be taken forthwith with reference to an apparent case of "covering" of an uncertified woman by a local practitioner, and asking the Board to make the necessary representations on the subject to the General Medical Council. The Board directed that the secretary be instructed to represent to the General Medical Council the case of "covering" reported by the Rotherham town council.

A letter was considered from the Midwives Institute transmitting a copy of a letter addressed by the institute to the Local Government Board dealing with the relation of a midwife to ante-natal hygiene. The Board decided that the letter of the Midwives Institute transmitting a copy of their memorial to the Local Government Board be acknowledged with thanks.

The following is the text of the memorial:—

The Memorial of the Incorporated Midwives Institute and its Affiliated Associations, representing Practising Midwives in all parts of England and Wales.

The midwives of the Incorporated Midwives Institute and the Associations of Midwives affiliated thereto ask to be allowed to place before you their views on a very important subject.

In common with all other experienced health workers they feel that in this crisis of our country's history every effort should be made to improve the health of the mothers of the nation and to lower infant mortality and ante-natal loss of life.

Certified midwives consider that they can be of special use in the ante-natal period and for the first ten days after childbirth for the following reasons: 1. The midwife enters the home as the friend and chosen attendant of the patient, who has engaged her services. She possesses her confidence as no uninvited official can do; the patient will confide to the midwife matters in regard to her health which she would confide to no one else; this is especially true of the unmarried mother. 2. The midwives of the present day are already an organised body of health workers under Act of Parliament, specially trained to recognise conditions which call for medical aid. They are under the strict rules of the Central Midwives' Board, by which they are bound to keep their patients under supervision from the time of booking till ten days after confinement.

Since, therefore, these are the duties and functions of the midwife, her patients should be encouraged to book early, but notification of pregnancy in any form is highly undesirable, for two reasons: on the mothers' side, when they realised that their pregnancies were being notified they would carefully conceal their condition, even from their midwife, with the result that they would only send for her at the last minute, rendering it impossible for her to advise and guide them during the ante-natal period, besides risking the life of the child at the time of birth. On the midwife's side it would be a gross breach of professional confidence, the midwife being no less bound than the doctor by a code of professional ethics.

To render ante-natal supervision effective midwives would wish to coöperate with centres to which their patients could be sent for adequate medical treatment when needed, and they would endeavour to see that their patients carried out the treatment prescribed. At present there is a lamentable break in the hygienic chain at this point. To discover the many ante-natal conditions that may lead to miscarriage, stillbirth, and the birth of weakly or diseased infants, is the aim and province of the midwife.

Therefore, since the midwife is specially trained for the duty of attending the mother professionally, she asks the health officials to recognise that she is the proper person to answer inquiries as to the health of mother and baby and the home conditions, and to receive instructions and see that they are carried out; thus obviating any necessity for worrying visits from health visitors or other officials.

And when the midwife's visits ceased she would willingly use her influence to ensure that the baby is handed on to whatever health authority would supervise it up to school age. In this way continuity of supervision without overlapping, friction, or waste of public funds would be secured, and the midwife would no longer be a wasted factor in the health scheme.

The objects that all have at heart are the same and coöperation is necessary for their attainment. Midwives ask that those who have not had their special advantages of training and experience shall accept their coöperation and

that willingness to coöperate shall not come from the side of the midwife only.

Again, the public hardly realises that more than 50 per cent. of all the births in England and Wales are attended by midwives, and as their work lies among the poorest classes it is estimated that at least 75 per cent of working mothers are attended by them. This is a very important section of the community; they are the mothers of our future soldiers and a very large proportion of them are in touch with no other health worker than their midwife, and it is for the benefit of these mothers and these infants that the certified midwives of England and Wales ask to be allowed to share in the endeavour to prevent those conditions that lead to the ill-health of the mother and the death or disablement of the infant.

R. P. FYNES-CLINTON,
Honorary Secretary, The Incorporated Midwives Institute, 12, Buckingham-street, Strand, W.C.

February, 1916.

A number of midwives were struck off the Roll on various charges.

THE SERVICES.

ROYAL ARMY MEDICAL CORPS.

Lieutenant-Colonel M. O'Halloran is retained on the Active List and to be supernumerary.

Temporary Honorary Lieutenant-Colonel R. T. Leiper to be temporary Lieutenant-Colonel.

Major R. S. Smyth retires on a gratuity.

R. D. Hotchkis to be temporary Major.

Temporary Captain F. A. A. Holmden, D.S.O., to be temporary Major.

Lieutenant G. Bouthellier, C.A.M.C., to be temporary Captain.

The undermentioned temporary Lieutenants to be temporary Captains:—J. H. Glover, G. Fildes, H. W. S. Wright, E. C. Malden, W. K. A. Richards, C. Roche, J. W. Gilbert, S. H. Browning, K. Playfair, J. H. Bampton, F. R. Harris, T. A. Watson, T. L. Enright, H. H. Weekes, A. H. Wilson, A. G. P. Hardwick, W. J. B. Selkirk, R. M. Fraser, W. D. Dunlop, T. H. F. Roberts, D. Wilson, G. W. B. James, B. R. Parmiter, J. W. McKinney, E. Tawse, J. D. Forrester, G. Smith, A. R. Wightman, R. A. Morrell, S. B. Radley, L. C. Dillon-Kelly, C. F. Dillon-Kelly, E. P. Leahy, R. Tindall, R. H. Liscombe, F. L. Cleland, A. Fullerton, E. E. Herga, W. A. Coats, T. E. Roberts, R. R. Armstrong, J. A. F. Hatch, M. Gross, A. W. Comber, W. Anderson, G. A. Shiel, H. Nicoll, H. C. Highet, and C. R. Nicholson.

The undermentioned to be temporary Captains:—J. R. H. Walker (late temporary Captain, Indian Medical Service), E. Black, Lieutenant (temporary Captain) A. D. Clinch (from Dublin University Officers Training Corps), Temporary Lieutenant A. Scott (late Surgeon, Royal Navy), and F. Harvey, C.A.M.C.

Temporary Captain A. H. James relinquishes his commission.

The undermentioned temporary Lieutenants relinquish their commissions:—F. P. Walsh, A. N. Craig, A. St. Johnston, G. L. Jones, R. L. E. Downer, G. Reid, W. Wiglesworth, and A. J. B. Leckie.

The undermentioned to be temporary Lieutenants:—G. A. McBride, Canadian Army Dental Corps, W. M. Buchanan, T. H. Agnew, A. N. Cox, H. E. Williams, H. de Lisle Crawford, W. W. Jones, C. B. F. Tivy, H. V. Forster, J. Bamforth, E. E. Semmence, G. Hart, J. Nunan, D. Smith, A. W. Jones, P. R. Eskell, J. W. Tonks, J. S. Part, D. J. Clark, L. R. H. P. Marshall, G. G. Buchanan, W. Garton, H. E. Whittingham, J. MacNamara, D. S. Robertson, J. H. C. Fegan, H. E. Allanson, J. McConnell, R. Younger, A. J. L. Speechly, G. T. L. Murphy, D. M. Morison, M. H. Fleming, C. E. Freeman, H. Smith, W. B. Sanders, D. J. Jones, C. H. G. Prance, H. J. Gater, G. G. Bartholomew, W. R. Knightley, P. M. Heath, H. C. Harrison, A. E. Seller, A. Cowe, J. E. Davies, J. C. Neil, W. MacLeod, O. B. Pratt, T. W. Wadsworth, E. H. Fennessy, S. T. Lewis, D. F. A. Neilson, H. V. Lamb, L. H. Terry, P. L. T. Bennett, J. H. Boag, W. F. MacAlevey, K. M. Nelson, A. H. Towers, H. S. Turner, P. P. Warren, P. W. White, H. G. Morris, and M. Ramsay.

Temporary Honorary Lieutenant B. Graves to be temporary Lieutenant.

T. A. Loughrey, C.A.M.C., to be temporary Honorary Lieutenant.

Temporary Lieutenant H. Malins relinquishes his commission on account of ill-health.

INDIAN MEDICAL SERVICE.

The King has approved the promotion of the following officers:—Captains to be Majors: Dated July 30th, 1915: Hugh Basil Drake, Ernest Charles Hodgson, William Sim McGillivray, William Gillitt, Charles Harrison Barber, William Tarr, Ivor Davenport Jones, Walter Taylor Finlayson, Hugh Ellis Stanger-Leathes, Michael Joseph Quirke, John Morgan Holmes, and Maurice Forbes White.

The King has approved the retirement of the undermentioned officers of the Indian Medical Service:—Lieutenant-Colonel George Sloan Thomson (dated Nov. 23rd, 1915) and Lieutenant-Colonel Clarence Barrymore Harrison.

SPECIAL RESERVE OF OFFICERS.

The undermentioned Captains to be temporary Majors while commanding the 40th Field Ambulance:—A. Glen and E. T. Burke.

The undermentioned Lieutenants to be Captains:—R. Stowers, R. O. Eades, R. A. Peters, J. A. Binning, S. Brown, J. Melvin, and J. E. Rusby.

Lieutenant C. G. Todd resigns on account of ill-health.

Lieutenants (on probation) G. T. Gimlette and W. Wyndham are confirmed in their rank.

TERRITORIAL FORCE.

Royal Army Medical Corps.

East Anglian Field Ambulance: Captain (temporary Major) J. R. Pooler to be temporary Lieutenant-Colonel whilst commanding a Field Ambulance. Captain Theophilus W. Morcom-Harneis, from Attached to Units other than Medical Units, to be Captain. Lieutenants J. E. Brooks, W. J. Dearden, and N. M. Smith to be Captains.

West Lancashire Field Ambulance: Captain F. W. K. Tough, from Attached to Units other than Medical Units, to be Captain.

London Field Ambulance: Captain D. D. Brown, from Attached to Units other than Medical Units, to be Captain.

Western General Hospital: Lieutenant E. W. Richards to be Captain.

London Sanitary Company: William J. FitzG. Mayne (late temporary Lieutenant, R.A.M.C.) and A. F. Girvan to be Lieutenants. Lieutenant S. L. Bartholomew relinquishes his commission on account of ill-health.

Wessex Field Ambulance: Captain H. W. Spaight, from Half-pay List, to be Captain.

London Casualty Clearing Station: Lieutenant H. Drummond to be Captain.

London General Hospital: Lieutenant-Colonel A. E. Garrod is seconded. A. Kingsford to be Captain, whose services will be available on mobilisation.

Scottish General Hospital: Lieutenant F. W. C. Brown to be Captain.

South-Eastern Mounted Brigade Field Ambulance: Captain W. Tresawna is seconded for d uty with the Duke of Cambridge's Own (Middlesex Regiment).

South Midland Mounted Brigade Field Ambulance: C. P. C. Sargent to be Lieutenant.

Yorkshire Mounted Brigade Field Ambulance: Lieutenant J. C. Denvir to be Captain.

Highland Field Ambulance: Lieutenant (temporary Captain) J. A. Stephen to be Captain. The undermentioned Lieutenants to be Captains:—H. G. Donald and J. W. McKeggie. Captain C. A. Whyte relinquishes his commission on account of ill-health.

Welsh Casualty Clearing Station: A. W. Clarke to be Lieutenant.

London (City of London) Field Ambulance: C. P. Sells to be Lieutenant.

Lowland Field Ambulance: Lieutenant R. Watson to be Captain.

Attached to Units other than Medical Units.—Lieutenants to be Captains: R. V. C. Ash, A. B. Winder, and Captain B. Hughes, from 1st West Riding Field Ambulance. M. Thompson to be Lieutenant

THE FRENCH MILITARY CROSS.

Captain E. D. Gairdner, R.A.M.C. (T.), attached to Royal Scots Fusiliers, 5th Battalion (T.), has been awarded the French Military Cross for services in Gallipoli Peninsula. Captain Gairdner is a son of the late Sir William Gairdner, K.C.B.

THE HEALTH OF THE NAVY.

At a meeting of the Royal Medical Benevolent Fund Guild, held at the Mansion House this week, Surgeon-General Sir Arthur May, the Director-General of the Medical Department of the Navy, incidentally remarked that notwithstanding the great hardships they had to undergo, the health of the men in our Fleet to-day was better than it had ever been since statistics of the Navy were first compiled.

APPOINTMENTS IN THE INDIAN MEDICAL SERVICE.

As has been already announced, after the open competitive examination held last July for admission to the Indian Medical Service no similar examination would be held during the continuance of the war, but that such appointments as might be required to meet the absolutely indispensable nee is of the service would be made by nomination by the Secretary of State. To assist him in making these appointments, which will be limited in number, Mr. Chamberlain has appointed a selection committee who will

summon and interview such applicants as may appear to be *primâ facie* suitable, and make recommendations for appointment. Applications for appointment should be addressed to the Secretary of the Military Department, India Office, Whitehall, S.W., and should contain concise particulars of the applicant's medical degrees and career. Applicants must be over 21 and under 32 years of age at the time of application. Particulars regarding pay, promotion, &c., in the service can be obtained from the Secretary, Military Department.

VITAL STATISTICS.

HEALTH OF ENGLISH TOWNS.

In the 96 English and Welsh towns with populations exceeding 50,000 persons at the last Census, 7284 births and 5685 deaths were registered during the week ended Saturday, Feb. 19th. The annual rate of mortality in these towns, which had been 14·0, 14·7, and 15·2 per 1000 in the three preceding weeks, rose in the week under notice to 16·3 per 1000 of their aggregate population, estimated at 18,136,180 persons at the middle of the year 1914. During the first seven weeks of the current quarter the mean annual death-rate in these towns averaged 14·7, against a corresponding rate of 13·9 per 1000 in London. Among the several towns the death-rate last week ranged from 4·6 in Ilford, 5·6 in Eastbourne, 7·0 in Wimbledon, 8·1 in Edmonton and 10·1 in Walthamstow to 22·1 in Oldham, 23·6 in Liverpool, 23·7 in Stockton-on-Tees, 24·1 in Dewsbury, and 27·7 in Blackpool.

The 5685 deaths from all causes were 388 in excess of the number in the previous week, and included 377 which were referred to the principal epidemic diseases, against numbers increasing from 305 to 345 in the four preceding weeks. Of these 377 deaths, 133 resulted from whooping-cough, 78 from measles, 73 from infantile diarrhœal diseases, 61 from diphtheria, 25 from scarlet fever, and 7 from enteric fever, but not one from small-pox. The annual death-rate from these diseases was equal to 1·1, against 1·0 per 1000 in each of the two preceding weeks. The deaths attributed to whooping-cough, which had increased from 74 to 121 in the four preceding weeks, further rose to 133, and included 42 in London, 16 in Liverpool, 8 in Birmingham, 7 in Manchester, 5 in Sheffield, and 4 each in Croydon and Coventry. The deaths referred to measles, which had been 62, 62, and 63 in the three preceding weeks, rose to 78, of which 8 were registered in London, 7 in Leicester, 6 each in Stockport and Burnley, and 5 each in Bristol and Stoke-on-Trent. The fatal cases of diarrhœa and enteritis (among infants under 2 years), which had been 68, 70, and 64 in the three preceding weeks, rose to 73, and included 19 in London, and 4 each in Stoke-on-Trent, Liverpool, Warrington, and Manchester. The deaths attributed to diphtheria, which had been 70, 63, and 71 in the three preceding weeks, fell to 61, of which 14 occurred in London, 4 in Stoke-on-Trent, and 3 each in Birmingham, St. Helens, and Salford. The deaths referred to scarlet fever, which had been 25, 28, and 18 in the three preceding weeks, rose to 25, and included 7 in London, 3 in St. Helens, and 2 in Newcastle-on-Tyne. The 7 fatal cases of enteric fever were slightly below the average in the earlier weeks of the quarter, and showed no excess in any individual town.

The number of scarlet fever patients under treatment in the Metropolitan Asylums Hospitals and the London Fever Hospital, which had declined from 2257 to 2108 in the four preceding weeks, further fell to 2059 on Saturday last; 215 new cases were admitted during the week, against 260, 253, and 196 in the three preceding weeks. These hospitals also contained on Saturday last 1624 cases of diphtheria, 190 of whooping-cough, 64 of measles, and 50 of enteric fever, but not one of small-pox. The 1319 deaths from all causes in London exceeded the number in the previous week by 81, and corresponded to an annual death-rate of 15·2 per 1000. The deaths referred to diseases of the respiratory system, which had been 231, 224, and 225 in the three preceding weeks, rose to 283 in the week under notice, but were 176 below the number registered in the corresponding week of last year.

Of the 5685 deaths from all causes in the 96 towns, 195 resulted from violence and 435 were the subject of coroners' inquests, while 1817 occurred in public institutions. The causes of 63, or 1·1 per cent., of the total deaths were not certified either by a registered medical practitioner or by a coroner after inquest. All the causes of death were duly certified in Leeds, Bristol, West Ham, Bradford, Hull, Newcastle-on-Tyne, and in 65 other smaller towns. Of the 63 uncertified causes, 12 were registered in Liverpool, 9 in Birmingham, 7 in London, and 4 in St. Helens.

HEALTH OF SCOTCH TOWNS.

In the 16 largest Scotch towns with an aggregate population estimated at 2,355,300 persons at the middle of this year, 977 births and 700 deaths were registered during the week ended Saturday, Feb. 19th. The annual rate of mortality in these towns, which had been 14·6, 13·4, and 16·3 per 1000 in the three preceding weeks, fell to 15·5 per 1000 in the week under notice. During the first seven weeks of the current quarter the mean annual death-rate in these towns averaged 15·1, against 14·7 per 1000 in the large English towns. Among the several towns the death-rate last week ranged from 7·8 in Ayr, 8·0 in Hamilton, and 8·9 in Kirkcaldy, to 16·8 in Kilmarnock, 17·5 in Paisley, and 29·8 in Coatbridge.

The 700 deaths from all causes were 34 fewer than the number in the previous week, and included 69 which were referred to the principal epidemic diseases, against 50 and 71 in the two preceding weeks. Of these 69 deaths, 34 resulted from measles, 15 from diphtheria, 11 from scarlet ever, 6 from infantile diarrhœal diseases, 2 from whooping-cough, and 1 from enteric fever, but not one from small-pox. The annual death-rate from these diseases was equal to 1·5, against 1·1 per 1000 in the large English towns. The deaths attributed to measles, which had been 29, 22, and 32 in the three preceding weeks, rose to 34, and included 18 in Glasgow, 10 in Coatbridge, 3 in Greenock, and 2 in Edinburgh. The deaths referred to diphtheria, which had been 15, 14, and 18, in the three preceding weeks, fell to 15, of which 4 belonged to Edinburgh, 3 to Glasgow, and 2 each to Dundee and Greenock. The fatal cases of scarlet fever, which had been 7, 7, and 11 in the three preceding weeks, were again 11 last week, and included 4 in Glasgow and 2 in Paisley. The deaths of infants (under 2 years) from diarrhœa and enteritis, which had been 13, 6, and 3 in the three preceding weeks, rose to 6, of which 4 were registered in Glasgow. The 2 deaths from whooping-cough were slightly below the average in the earlier weeks of the quarter, and were recorded in Coatbridge and Kirkcaldy. The fatal case of enteric fever occurred in Glasgow.

The deaths referred to diseases of the respiratory system, which had been 97, 73, and 96 in the three preceding weeks, fell to 88 in the week under notice, and were 177 below the number registered in the corresponding week of last year. The deaths from violence numbered 35, against 23 and 34 in the two preceding weeks.

HEALTH OF IRISH TOWNS.

In the 19 town districts of Ireland 506 births and 444 deaths were registered during the week ended Saturday, Feb. 12th. The annual rate of mortality in these towns, which had been 17·9, 17·6, and 19·0 per 1000 in the three preceding weeks, further rose to 20·2 per 1000 in the week under notice. During the first six weeks of the current quarter the mean annual death-rate averaged 18·8, against corresponding rates of 14·4 and 15·0 per 1000 in the English and Scotch towns respectively. The death-rate during the week was equal to 21·0 in Dublin (against 14·3 in London and 16·7 in Glasgow), 18·9 in Belfast, 22·4 in Cork, 21·5 in Londonderry, 21·7 in Limerick, and 19·0 in Waterford, while in the 13 smaller towns the mean rate was equal to 19·5 per 1000.

The 444 deaths from all causes were 25 in excess of the number in the previous week, and included 34 which were referred to the principal epidemic diseases, against 27 and 30 in the two preceding weeks. Of these 34 deaths, 12 resulted from whooping-cough, 10 from measles, 4 each from infantile diarrhœal diseases and scarlet fever, and 2 each from enteric fever and diphtheria, but not one from small-pox. The annual death-rate from these diseases was equal to 1·5, against corresponding rates of 1·0 and 1·6 per 1000 in the English and Scotch towns respectively. The deaths attributed to whooping-cough, which had been 8, 7, and 11 in the three preceding weeks, were 12 in the week under review, and comprised 5 in Belfast, 4 in Dublin, 2 in Limerick, and 1 in Portadown. The deaths referred to measles, which had declined from 14 to 5 in the four preceding weeks, rose to 10, and included 4 in Belfast and 2 each in Dublin and Newry. The fatal cases of diarrhœa and enteritis (among infants under 2 years), which had been 8 in each of the three preceding weeks, fell to 4, of which 3 occurred in Dublin and 1 in Belfast. The 4 deaths attributed to scarlet fever, which were slightly in excess of the average in the earlier weeks of the quarter, included 2 each in Dublin and Belfast. The 2 fatal cases of enteric fever were registered in Dublin and those of diphtheria in Dublin and Belfast.

The deaths referred to diseases of the respiratory system, which had been 63, 63, and 76 in the three preceding weeks, further rose to 83 in the week under notice, but were 94 below the number registered in the corresponding week of last year. Of the 444 deaths from all causes, 126, or 28 per cent., occurred in public institutions, and 7 resulted from violence. The causes of 23, or 5·2 per cent., of the total deaths were not certified either by a registered medical practitioner or by a coroner after inquest, and included 5 in Belfast, 4 in Limerick, and 3 in Cork; in the large English towns the proportion of uncertified causes did not exceed 1·0 per cent.

Correspondence.

"Audi alteram partem."

THE PRESENT POSITION OF MIDWIVES.

To the Editor of THE LANCET.

SIR,—With five years' experience as an inspector of midwives I have some knowledge of their requirements, of their difficult and uphill work, and of the ever-increasing demands made upon them. There is a very large number of midwives at the present time who do not practise. Of those who are willing to do so a relatively small number practise as midwives for reasons which I shall presently explain. The steady depletion of medical men must certainly throw increased responsibility upon the midwife, but if the midwife also fails, what then is the position? By making clear the causes for this deadlock the first step will be taken towards its removal. They may briefly be summed up as follows: (1) Inadequate remuneration; (2) no inducement to practise; (3) active opposition in many parts of the country; (4) to these must be added, though in lesser degree, the practice of the uncertified woman whose work also may be in some instances condoned or regulated by a medical man.

Now when it is considered that there is no profession in the world of more importance to humanity, none on which the future of the race is more dependent, and none of which more is expected in this country, then surely it is matter for surprise to find that there is no profession more heavily handicapped or which meets with less encouragement in the performance of its duties. The midwife leads an arduous and harassing existence. The great majority of women practising "on their own" finds even a hardly wrung maintenance unattainable. It is a very small percentage indeed that is able to secure a competency. In several counties there is still a strong feeling against the midwife who essays to take cases without a doctor. The medical man is jealous of what he believes to be his privilege, and will not tolerate any encroachment thereon. Not so long ago in a district nursing association the engagement of a nurse with a Central Midwives Board certificate was objected to lest it should be proved to be the thin end of the wedge.

The uncertified woman.—In a good many places these women are permitted by doctors to help them in the confinements and take care of the mother and child afterwards. As a consequence there is much complaint by the midwife who objects to the preference shown to the untrained woman. It is conceivable that in some instances also these methods may be responsible for the covering of unauthorised work.

Bonâ fide midwives.—This class is still fairly numerous, though gradually dying out or being otherwise got rid of; nevertheless, it is becoming increasingly difficult, for the reasons I have stated, to fill her place. Her clientèle is often taken from amongst the most wretchedly poor. She is more or less of their class, lives among them, shares their feelings and sympathies. She may tramp miles under all sorts of conditions to attend the mother and child. She generally does the housework as well. She labours for a mere pittance. When she disappears who will succeed her? The neighbourhood could not support a trained woman, even if it were in the least likely a trained woman would go there under present conditions. What, then, will become of many of these poor mothers? One can only surmise that unless adequate means are adopted there will be a lamentable lapse to the tender mercies of the handy woman.

At present the midwives who lead the most tolerable lives are those salaried and protected by the nursing associations and kindred bodies. Yet it must be remembered that by far the greatest number of these women take confinements only with a doctor, and that though in a high percentage of cases he is not present at the birth, yet he is responsible for the fees and the general conduct of the case.

Now, whether a comprehensive scheme on the lines and under the ægis of the nursing organisations could be evolved, or whether the midwife as an individual is to be permitted a place under the sun, or whether, perhaps best of all, a combination of both these methods might be effected, is a matter for the consideration of experts. Only, what is to be done let it be done quickly. The "Wait and see" policy is fatal here. While we are hesitating the unnecessary loss in infant life goes steadily on. Unless remedial measures are taken at once, and at least a tentative scheme be put in hand, the waste of our most precious national asset must inevitably continue.

I am, Sir, yours faithfully,

L. E. ROGERS,
Inspector of Midwives.

Feb. 12th, 1916.

INFECTIVITY OF SCARLET FEVER.

To the Editor of THE LANCET.

SIR,—The School Code of Rules published in your issue of Feb. 19th (p. 418) contains, as you observe, many modifications of interest, but it is curious that the annotation passed over without comment the point which is most striking of all, that is, the rule for the isolation of scarlet fever patients. I was delighted to see that this rule reduces the minimum detention of scarlet fever cases to four weeks from the traditional six, and, though it does not say so in so many words, obviously disregards the risk of desquamated skin after that time. Some of us, who have firmly believed for many years that the hospital detention of these patients is unnecessarily long, have yet been met with sufficient professional and popular prejudice to prevent us carrying out our principles to the full. In my own case I have for long paid no attention to late desquamation, but have seldom ventured to discharge a scarlet fever patient before five weeks from the onset. The new rules show a most welcome change in responsible medical opinion, and it is to be hoped that at the present moment, when we are all asked to be economical, they will be followed by local authorities anxious to reduce hospital expenditure.

I am, Sir, yours faithfully,

CLAUDE B. KER, M.D., F.R.C.P. Edin.

Edinburgh, Feb. 21st, 1916.

MATRICULATION AT THE UNIVERSITY OF MANCHESTER.

To the Editor of THE LANCET.

SIR,—In your issue of Feb. 12th Professor Elliot Smith, Dean of the Medical Faculty of the University of Manchester, says that in a report of the Committee of Management to the Royal College of Physicians, "it has been stated that Latin is no longer a compulsory subject in the entrance examination to the Faculty of Medicine in the University of Manchester."

The actual words of the report are :—

The attention of the committee has been drawn to the fact that students may now matriculate at the Universities of Manchester, Liverpool, Leeds, Sheffield, and Birmingham without passing in Latin.

Nothing is said of medical students or of the medical faculty. At the Comitia of this College, when this report was discussed and adopted, the fact that the University of Manchester required Latin in addition for its medical degrees was pointed out by the President. But that matriculation in other faculties can be taken at Manchester without Latin, may be seen from the University Calendar, where Latin is in the list of optional subjects.

The point of the committee's report was that the Conjoint Board having for 13 years accepted, as a preliminary to medical studies, the matriculation examination of the University of London without Latin, should, as a matter of common sense, recognise a similar examination in other Universities.

I am, Sir, yours faithfully,

J. A. ORMEROD,
Registrar.

Royal College of Physicians, London, S.W., Feb. 17th, 1916.

INVERSION OF THE PELVIC BONES.

To the Editor of THE LANCET.

SIR,—I am glad Professor Elliot Smith recognised in your issue of Feb. 19th that I had fully acknowledged in my paper my "indebtedness to Dr. Douglas E. Derry's and Professor Wood Jones's work." He tacitly concedes my remark on the use of the well-known term "inversion," but I hasten to add that Professor Wood Jones made it quite clear to me in his contribution to the Nubian Monograph that his interesting cases were really due to the presence of a male element in the pelvis and caused delay in labour. The mere term is of little importance. I still hold that Zaaijer deserves credit for his work on the sulcus preauricularis, as Dr. Douglas E. Derry pointed out.

I hope that this discussion will direct the attention of obstetricians to the valuable facts of Professor Elliot Smith's and Professor Wood Jones's monograph, and especially to the great significance of the lateral aspect of the pelvis. Hitherto this view of the pelvis has been little figured or considered.

I am, Sir, yours faithfully,

Edinburgh, Feb. 21st, 1916. D. BERRY HART.

ULCERS NEW AND OLD.

To the Editor of THE LANCET.

SIR,—As gastric ulcer has a wide range of distribution I take it that ulceration at any point of the *prima via* is of interest now that Sir John Bland-Sutton has so much enlightened us in his Hunterian lecture on this subject.[1]

In 1899 I was consulted by a lady, aged 56, married, who had been the subject of chronic dyspepsia for some years, characterised by pain after food, weight, eructation, and gnawing discomfort; the locality varied, but always pointed to the umbilicus. The usual remedies of bismuth and alkalies generally relieved her attacks. In the intervals of attendance she took "Cockle's pills." There was no history of anæmia, of thrombosis, or of hæmorrhage, and her attacks were set down to stercoral or toxic states. Added to her symptoms in August, 1899, she had severe colic and constipation, for the relief of which I prescribed an oily emulsion of castor oil (℥ ss.), olive oil (℥ 1½), and clove oil (♏ i.). Immediate relief followed on the ensuing morning, but later on in the same day she was taken with all the signs of perforation, with chymous, and later stercoral, vomit, acute pain, a fixed diaphragm, critical sweating, and every indication of approaching death. A surgeon was summoned, but arrived four hours too late. A post-mortem examination (in which I was assisted by Dr. Howard O. Davies) revealed a clean stercoral ulcer, circular, ¼ inch in diameter, through the longitudinal band of the transverse colon. All the coats of the gut but the peritoneal had long been eroded, and she had probably been saved a much earlier death by the unique site of the ulcer, unaffected by muscular action of a direct character. A serpentine outflow of pultaceous matter had taken place into the peritoneum. The specimen is now in the pathological museum of St. Mary's Hospital.

I am, Sir, yours faithfully,

HERBERT A. SMITH, M.D.

Madeley-road, Ealing, W., Feb. 21st, 1916.

[1] THE LANCET, Feb. 19th, 1916, p. 387.

THE EXAMINATION OF THE SOLDIER'S HEART.

To the Editor of THE LANCET.

SIR,—Since writing my note on this subject in THE LANCET of Feb. 5th, opportunity has been afforded me by the kindness of Major Parsons and Dr. Florence Stoney of examining eight cases of "soldier's heart." Dr. Stoney accompanied me, and at my request did not tell me anything about the patients until after I had concluded the examination. Of these eight, in six the ratio of the first and second sound was normal, and therefore I concluded that the condition was not due to any infection; but in the other two, the ratio was 1 instead of 2. Dr. Stoney told me that of these two cases one had had dysentery; of the six cases of normal ratio trouble had followed shell-shock. The remaining case with an altered ratio had been ill for more than 12 months, and showed most of the signs of a well-marked case of Graves's disease.

I am, Sir, yours faithfully,

Portland-place, W., Feb. 16th, 1916. O. LEYTON.

A DAUGHTER OF THE LATE SIR JOHN HUMPHREYS.

To the Editor of THE LANCET.

SIR,—I shall be grateful if you will allow me to make an appeal on behalf of a very interesting case. Doubtless many of your readers will remember the late Sir John Humphreys. He died 20 years ago, was coroner for Middlesex and a colleague of the former Editor of THE LANCET. Perhaps among your readers there are some of his old friends who still remember his personality and attainments. It is on behalf of Sir John Humphreys's daughter, Mrs. Ellen Hunt Foulston, that I wish to appeal. She is a candidate for a pension from the Royal Hospital for Incurables, Putney Heath. The next election will be held in May. She is an incurable invalid, crippled with rheumatoid arthritis, and in the autumn of her life she has been left without any income whatever. Her sole means of support are derived from a few old friends, but this, with all the generosity they have shown, cannot be regarded as permanent.

I am aware that for success at an election of the Royal Hospital for Incurables about 1400 or 1500 votes are necessary, and, large as this number is, I think there should not be great difficulty in securing them for Mrs. Hunt Foulston. I shall be happy to send some of the candidate's cards to

anyone who is prepared to help. I ought also to mention that votes for one election are available at the rate of four per guinea. Full information on this point may be obtained from the secretary of the Royal Hospital for Incurables at the City offices, 4, St. Paul's Churchyard.

I am, Sir, yours faithfully,

JOHN GAY, M.D. Durh.

37, Upper Richmond-road, Putney, S.W., Feb. 16th, 1916.

NOTES FROM INDIA.

(FROM OUR OWN CORRESPONDENTS.)

The Punjab Medical Registration Bill.

THE Punjab Medical Union has addressed an emphatic protest to the Secretary of the Provincial Legislative Council against the Punjab Medical Registration Bill, recently introduced into the Council. It is argued that the Bill as it stands is calculated seriously to prejudice the interests of the independent medical profession in the province, to lower its social and professional status, and to impose on it hard and uncalled-for restrictions without conferring compensating advantages or discouraging the continuance of unqualified practice. It is assumed that a Bill on the lines of the Registration Acts in the Presidencies is unsuited to the Punjab, because the proportion of independent practitioners to those in Government service is very much smaller than in the Presidencies. It is argued that while it affects adversely the independent practitioners of Western medicine, the Bill strikes at the root of all progress and improvement in the indigenous systems of medicine, the existence of which is considered absolutely essential in the present conditions of the province. For these and other reasons the Medical Union urges that if legislation in the matter cannot take better shape the Bill should be abandoned altogether. Failing this, the committee of the union urges the amendment of the Bill in various directions—e.g., by refusing registration to military assistant surgeons, hospital assistants, or sub-assistant surgeons, or by registering them on a separate and inferior register. It urges that the constitution of the proposed Medical Council is radically defective, that there are no reasons to justify a strong official majority on the council, and that the independent medical practitioner should have far larger representation on it than is at present proposed. It objects to the disciplinary powers proposed to be granted to the council, asks that the offences for which a member may be removed from the register shall be clearly defined, and that even after a two-thirds majority of the Medical Council have decided on the removal of any name from the register there shall be an appeal to the Chief Court against the council's decision.

Annual Report of the Imperial Bacteriologist.

The annual report of the Imperial bacteriologist records its appreciation of the work of the late Lieutenant-Colonel J. D. E. Holmes, head of the laboratory, whose research work during his seven years' tenure was of the greatest value to the country, largely enhancing the output of sera and vaccines for the various diseases of equines and bovines. Mr. A. W. Shilston, the present head, states that the issues of sera, vaccines, and diagnostic agents from the laboratory during the year exceeded by nearly 4 lakhs of doses the highest figure attained in any previous year. The demand for serum in India is increasing very rapidly, and the need for expansion to meet the growing demands of the country is very evident. In the previous year the output of the laboratories was very greatly decreased by the breakdown of the electric centrifuges, and the new ones ordered have, owing to the war, not yet been received. By constant care and attention it has been possible to keep four of the seven old centrifuges running throughout the year, but the need for new machinery and for an improved water-supply is very urgent. Extensive experiments have been made with the object of discovering a method of treatment for rinderpest. The anti-rinderpest serum is a prophylactic agent of little curative value, and no means is yet known of saving the lives of animals when once they are infected. During the year a very large number of drugs were tested singly and in combination, but up to the present none have been found to exert any marked influence on the course of the disease. Experiments were also made to test the length of time that anti-rinderpest serum will retain its protective value. If kept at a temperature below 90° F., as in a cellar or ice-box, it remains potent for at least two years, so that it can be kept, even in the plains, ready for use at short notice. Experiments were also made as to the effects of drugs on anthrax. Certain compounds of iodine were found to exercise a decided effect on the disease, but in no case were the results sufficiently conclusive to warrant their employment being recommended.

The Health of Bombay.

Statistics now available regarding the health of this city during the past year show that it has been a year of which Dr. J. A. Turner and his subordinates may well be proud. The total mortality was 23,631, and the death-rate 24·17, against a mortality of 31,853, and a death-rate of 32·52 registered in 1914. Thus, in spite of the large increase of population that has taken place, the year 1915 witnessed the lowest mortality on record since 1890, with the exception of 1893, when the mortality was 23,142. The number of plague deaths during the past year was 599, the lowest on record, and a welcome decrease from the previous year, when it was 2,941.

The late Colonel G. F. W. Braide, I.M.S.

Lieutenant-Colonel G. F. W. Braide, I.M.S., died suddenly on Dec. 30th, 1915, from an attack of pneumonia. He was an officer of exceptional experience in jail administration, and had held the post of Inspector-General of Prisons in the Punjab during the last nine years. Born in 1862, he entered the Indian Medical Service in 1887, and after being in military employ for three years entered the Punjab Jail Department as officiating superintendent of the Central Jail in Multan in 1890. After a brief spell as civil surgeon at Gujrat, he returned to the Jail Department, in which he had remained ever since. Colonel Braide was an enthusiast in jail administration, with a strong belief in the reformatory side of prison discipline. He was a man of decided views who was never afraid to give expression to them in his departmental reports, and it was not uncommon to find the inspector-general's views vigorously contested by the lieutenant-governor in his resolutions on the yearly jail reports. Socially Colonel Braide will be much missed in Lahore, where his geniality and bonhomie made him many friends.

Jan. 30th.

Obituary.

SIR WILLIAM TURNER, K.C.B., D.C.L. OXON., LL.D. CANTAB., F.R.S.,

PRINCIPAL OF THE UNIVERSITY OF EDINBURGH; LATE PROFESSOR OF ANATOMY IN THE UNIVERSITY AND PRESIDENT OF THE GENERAL MEDICAL COUNCIL.

Sir William Turner, Principal and Vice-Chancellor of the University of Edinburgh, died at his residence at Edinburgh on Tuesday, Feb. 15th, as we have already briefly announced. He was in his eighty-fifth year. Up to the beginning of the month he had discharged his various and heavy official duties apparently in his usual health, which was robust, but a chill from which he was suffering at a meeting of the Senatus Academicus on Feb. 3rd developed in a rapid manner, so that it became clear that only one end could be expected in a subject of such advanced age.

Sir William Turner was always regarded as a typical Scotsman; as a matter of fact, he was the son of an English father, William Turner, of Lancaster, though his mother was born Margaret Aldren, a Scotswoman. He was born in 1832, was educated at home and at private schools, and entered as a student at St. Bartholomew's Hospital in 1850. At this time the staff of St. Bartholomew's Hospital was not particularly strong, though among those in charge of in-patients it included Sir George Burrows, son-in-law of the great Abernethy, and Sir William Lawrence. Sir James Paget was an assistant surgeon, who had already made his mark as a pathologist, and it was from him that Turner received his main assistance when his high scientific bent became pronounced. He was a successful student at the hospital, obtained the M.R.C.S. in 1853, and graduated with honours at the University of London in 1857. By that time he had left London and had already embarked upon a career that was to be crowned with such complete and progressive success. For he was selected in 1854 by Professor Edward Goodsir, the famous professor of anatomy, to be his senior demonstrator at Edinburgh. For the next 62 years—that is to say, until his death—William Turner was associated with the fortunes of the University of Edinburgh, especially with those of its famous medical faculty. Goodsir died in 1867, and his assistant, who had already made his mark both as a teacher and an original investigator, was appointed to the vacant chair, which he occupied for the long period of 36 years. It is always an invidious thing to describe any particular epoch in the career of an institution as a particularly brilliant one, and of the University of Edinburgh it may be fairly said that for the last 100 years its medical faculty has been one of the most successful and distinguished centres of medical knowledge in the world. But perhaps at the time that Turner was appointed demonstrator of anatomy the quality of the work at Edinburgh and the scientific status of the professoriate were more marked than before or since. Goodsir was the leading anatomist of the day; Edward Forbes, who died the year of Turner's appointment, was professor of natural history; Christison was the professor of clinical medicine; Syme was the professor of surgery and esteemed the first living exponent of his art; Alison and Hughes Bennett were also of the teaching staff; and Sir James Young Simpson, the introducer of chloroform, was the professor of midwifery. To the repute of the University under such leaders Turner soon showed that he was able to add.

Professor Arthur Robinson writes in the following terms of his predecessor in the chair of anatomy:—

Sir William Turner became an anatomist in 1854, and he remained an anatomist until his death in 1916. During the intervening period he published 276 communications, of which 26 were addresses mainly on anatomical or medical subjects and four were memorial notices. The remainder dealt with human anatomy, human physiology and human pathology, comparative anatomy, and anthropology. In addition, he edited Sir James Paget's "Lectures on Surgical Pathology" and the collected works of Goodsir and of Rolleston, and he was for a long period the editor of the *Journal of Anatomy and Physiology*. Such a catalogue of completed work would serve, for most men, as a sufficient index of a very active life, but it indicates only a part, and perhaps not the largest or most important part, of Sir William Turner's life-work, for he was in addition a great teacher, organiser, and director.

Many of his papers on human anatomy dealt merely with conditions which are present, regularly or occasionally, in the human body, but even these threw new light on the subject under discussion, whilst his "Relations of the Human Cerebrum to the Outer Surface of the Skull and Head" was a pioneer communication on cranio-cerebral topography, and his description on a "System of Anastomosing Arteries between and connecting the Visceral and Parietal Branches of the Abdominal Aorta" and that on a "Supplementary Supply System of Nutrient Arteries for the Lungs" drew attention to conditions previously unrecognised and of great practical importance. His work in the domain of comparative anatomy included invertebrates, fish, and mammals; but that which was most outstanding, which corrected errors, discovered previously unknown facts, and paved the way for further advances was his work on the placentation of mammals and that on the various groups of Cetacea. His work on the placenta commenced in 1871, it culminated in his lectures on the Comparative Anatomy of the Placenta, delivered in the Royal College of Surgeons of England in 1876, and it was continued, at intervals, on isolated specimens till 1889. His work on Cetacea was even more extensive than that on the placenta; it simplified the classification of the groups, and placed the subject on a sounder footing than it had previously enjoyed. His work in anthropology, and the advances he made in that department of anatomy are, perhaps, better known to the general public than his work on the placenta and the Cetacea. In it he dealt with both prehistoric and present-day man, he discussed the differences between various races, indicated new methods for their estimation, and suggested reasons for believing in the delimination of different groups. In this section of research some of his most interesting memoirs are those dealing with the "Craniology of the People of Scotland" and those in which he discusses the "Craniology of the People of the Empire of India." In his writings he is never ambiguous; his statements are clear and definite, and the accuracy of his data, which is remarkable, gives us an insight into that part of his character which made him so great a teacher. He never attempted to expound any subject until he had it quite clear in his own mind. That end once gained he had no difficulty in making any subject quite clear to his audience, the prearranged details were gradually evolved until the whole stood out in plain relief, and his audience departed thinking that it was quite a simple matter which had been discussed, and often not recognising the amount of work and thought which had been expended in bringing about that effect.

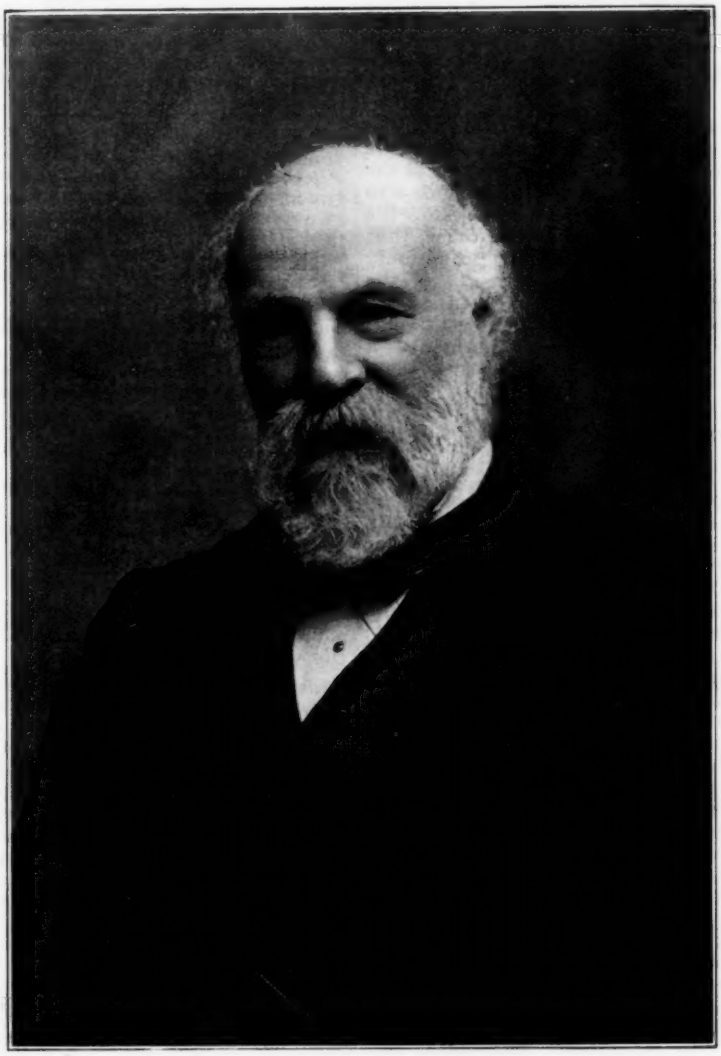
He was a believer in and an asserter of authority, but in his class work he insisted upon his students verifying facts for themselves; moreover, both as a teacher and an investigator he was so enthusiastic and stimulating that, for a long time, the majority of anatomical posts in the United Kingdom and the colonies were occupied by his pupils. He had a natural faculty for observation and exposition, and those two gifts, coupled with a firm belief for the necessity of work, care, and accuracy, made him the great man he was.

It was something other than those things, however, which gathered to him, in so large a degree, the respect and esteem

of those who worked with him; something which was hidden, at times, under a superficial severity, but which showed itself in his genial courtesy, and that was a great sympathy with human endeavour, even when that endeavour was somewhat frail and halting.

Sir William Turner's ability as a demonstrator, his industry, and successful management of students alike indicated his selection for the post of Principal of the University, which became vacant in 1903 on the death of Sir William Muir. He was 70 years of age, but his alert mind and vigorous health promised complete ability to carry out the duties of Principal, while he had already shown that he was able to take a broad view and attend to other matters than the specialty for which he occupied the important chair.

Edinburgh University has had many eminent Principals, from the time of Carstairs in 1703 down to the days of Sir David Brewster, Sir Alexander Grant, Sir William Muir, and Sir William Turner, but none of them did more genuine service to the University or lived through greater developments, at least in later years, than Sir William Turner. His abounding vitality, his devotion to the University, in which all his teaching had been done, and his high sense of duty alike impelled him to welcome the new responsibilities offered to him, and looking back over the 13 years that have elapsed since then no past or present student of the University can regret that her destinies were entrusted to his care. The Carnegie Foundation for the Scottish Universities had just been instituted when he assumed office, and it was necessary that this new source of income should be wisely arranged. For such a task no better Principal could have been found. Thoroughly experienced in university administration, a sound business man, and a wise and cautious counsellor, he saw that the money was devoted to objects that would really advance the standing of the University, and which, while increasing opportunities for fruitful study, did not impose upon the College finances a new burden heavier than they could bear.



SIR WILLIAM TURNER, K.C.B., F.R.S.

[Reproduced from a photograph by Messrs. Elliott and Fry.

In 1873 he was elected representative of the Universities of Edinburgh and Aberdeen on the General Medical Council, a post which he held till 1883, when for three years the Universities sent Sir John Struthers to represent them. Re-elected again in 1886, he held office until 1905, being elected President on the death of Sir Richard Quain in 1898. During Sir William Turner's seven years' tenure of the important post of President of the General Medical Council the business capacity of that body very greatly developed. Under Sir Richard Quain the debates were too often characterised by long speeches not to the point, and not infrequently by personal interludes of an unfortunate character. Beneath Sir William Turner's rule the debates became far more severely business-like, while the members of the Council soon felt the guidance of an enlightened authority under whom to discuss problems of medical education. During Sir William Turner's presidency the Council took measures to make it illegal for a company to carry on under the Companies Acts the profession or business of physician, surgeon, or dentist. The Boer War gave an impetus to another important movement in which Turner took a deep interest—viz., the extension of the Medical Acts so as to get real reciprocity in medical practice between Great

Britain and her colonies. The advantage of admitting colonial practitioners to the naval and military medical services was an obvious argument in favour of reform, and the day is approaching when real reciprocity will be instituted. Turner had been a member of the Royal Commission on the Medical Acts, and such questions were familiar to him in all their phases. The abuses to which the medical profession was subject under medical aid associations were ventilated in full at meetings of the Council in the "nineties," and the recognition of the existence of grave professional difficulties, which then took place, proved later of great value when the position of medical men under the National Health Insurance Act was considered. The Midwives Act was passed while Turner presided over the Council, and many of the debates required firm ruling by the President, who himself took an active part in caring for the interests of the medical profession under that much-debated piece of legislation. The preliminary negotiations for the sale of the property of the Council in Oxford-street were undertaken during his presidency, and in all these widely different matters the personal influence of Turner as a capable organiser and a shrewd man of business was felt.

It was natural that such a full and valuable life should be associated with many personal honours and distinctions. Knighted in 1886, Sir William Turner was given the K.C.B. in 1901, the year following his presidency of the British Association for the Advancement of Science. He was a D.C.L. of the Universities of Oxford, Durham, and Toronto; a D.Sc. of the Universities of Cambridge and Dublin; an LL.D. of the Universities of Glasgow, St. Andrews, Aberdeen, and Montreal; F.R.S. of London and Edinburgh, of which latter body he was President; and a member of a vast number of learned societies. He was Vice-Chancellor of the University of Edinburgh, had delivered official lectures in anatomy at the Royal College of Surgeons of England, of which he was an honorary Fellow, and had served as President of the Royal College of Surgeons of Edinburgh.

Sir William Turner was a keen traveller, and knew Italy, France, and Belgium very well. He was especially interested in church architecture, and knew the cathedrals of his own country and the three continental countries very well. He was also an enthusiastic Volunteer, one of the original members of the University Corps, retiring in 1890 with the rank of Lieutenant-Colonel and the V.D. Sir William Turner married in 1863 Agnes (who died in 1908), eldest daughter of Abraham Logan, of Burnhouses, Berwickshire, by whom he had three sons and two daughters. The eldest son, Dr. Aldren Turner, is physician to King's College Hospital, London, and the second son, Dr. Logan Turner, is the surgeon for diseases of the ear and throat at the Royal Infirmary, Edinburgh.

THE CROYDON RED CROSS WEEK.—The Red Cross Week at Croydon, which opened on Jan. 22nd, has produced a net profit of £6501. A cheque for that sum was handed to Sir Charles Russell, chairman of the Collection Committee of the Red Cross Society, by Mr. Ian Malcolm, M.P., on Feb. 17th.

A NOVA SCOTIA HOSPITAL UNIT.—A second hospital unit, consisting of 12 medical men, 35 nurses, and some 125 attendants, has been offered to the War Office by the Province of Nova Scotia. The University of St. Francis Xavier, Antigonish, is responsible for the new unit, which will be under the command of Captain McLeod, C.A.M.C.

The War.

THE CASUALTY LIST.

THE following names of medical officers appear among the casualties announced since our last issue:—

Killed.

Lieutenant F. S. Mitchell, R.A.M.C., graduated at Dublin University early in 1915, and thereupon joined the Royal Army Medical Corps.

Lieutenant B. B. Gough, R.A.M.C., attached to the 8th Battalion South Staffordshire Regiment, received his medical education at Guy's Hospital, and qualified in 1897. Previous to joining the R.A.M.C. in June, 1915, he was in practice at Compton Martin, near Bristol.

Died of Wounds.

Captain A. R. S. Alexander, I.M.S., attached to the 2/7th Gurkha Rifles.

Died.

Lieutenant P. Pattison, R.A.M.C., graduated at Edinburgh University in 1901, and was Assistant Medical Officer of Health for Fife and Kinross prior to joining the R.A.M.C. in November, 1914.

Wounded.

Captain W. M. Biden, R.A.M.C., attached to the 2nd Leinster Regiment.

Captain H. B. Cunningham, R.A.M.C. (T.F.), attached to the Royal Field Artillery, 3rd Northumbrian (County of Durham) Brigade (T.F.).

DEATHS AMONG THE SONS OF MEDICAL MEN.

The following sons of medical men must be added to our lists of those who have fallen during the war:—

Captain K. R. Habershon, 12th Battalion Rifle Brigade, second son of the late Dr. S. H. Habershon, of Harley-street, London.

Captain A. R. S. Alexander, I.M.S., son of Dr. S. Alexander, of Hampstead, London.

R. E. Griffiths, eldest son of the late Dr. H. T. Griffiths, of Kensington-square, London, W.

Lieutenant J. T. Waite, 5th East Kent Regiment (T.F.), The Buffs, eldest son of the late Dr. Waite, of Halifax, Yorkshire.

Captain and Adjutant I. E. Griffin, 1/4th Battalion, Oxfordshire and Buckinghamshire Light Infantry, son of the late Dr. I. Griffin, medical officer of health of Banbury.

THE CENTRAL MEDICAL WAR COMMITTEE: THE CALLING UP OF MEDICAL PRACTITIONERS.

On Wednesday afternoon, Feb. 23rd, the Director-General of the Army Medical Staff received the Executive Subcommittee of the Central Medical War Committee, when the procedure on calling up of medical practitioners for military service was considered. [Minute No. 148 of the Proceedings of the Central Medical War Committee.] The relation of medical practitioners to the group system was explained, it may be remembered, by an official communiqué from the War Office, dated Jan. 12th, 1916 (see THE LANCET, Jan. 15th, 1916, p. 163). By command of the Army Council the following order was later promulgated:—No qualified medical practitioner who has been attested under the group system is to be called up for service with the colours. If a man who has been called up for military service under his group proves to be a

qualified medical practitioner he should be sent back to his home, and will continue in the Reserve unless selected for a commission in the Royal Army Medical Corps.

Sir Robert Morant interviewed Sir Reginald Brade, secretary to the War Office, with regard to the instructions contained in Minute No. 148 which was not consistent with the official communiqué.

Sir Reginald Brade recognised the discrepancy, and as a result the Army Council Instruction, *re* Calling up Medical Practitioners, is amended, we understand, to read as follows:—

1. No qualified medical practitioner who has been attested under the group system is to be called up for service with the colours except as provided in paragraph (3) below.

2. If a man who has been called up for military service under his group proves to be a qualified medical practitioner, he should be asked whether he had enrolled, or is intending to enrol, under the officially recognised Enrolment Scheme of the Central Medical War Committee as willing to take a commission (if ordered it) in the Royal Army Medical Corps. On producing his certificate of that enrolment to the Recruiting Authority, the latter will mark him accordingly in the list, and he will be sent back to his home and will continue in the Reserve until selected for a commission in the Royal Army Medical Corps.

3. If the practitioner does *not* produce the Enrolment Certificate his case can be dealt with by the Local Tribunal in the usual way, except that, if he pleads professional reasons for exemption—e.g., that he is indispensable by reason of the medical needs of the population—the case should be referred to the Central Tribunal.

The Central Tribunal will refer these cases, where indispensability is urged, to the Central Medical War Committee.

Armlets and Attestation.

The attention of all medical men who are single and under the age of 41 next birthday, and who are enrolled with the Central Medical War Committee, is called to the fact that they can only obtain armlets under the Derby scheme if they are attested. The period for attesting terminates automatically when the provisions of the Military Service Act come into force on Thursday next, March 2nd. It is important, therefore, that every medical man to whom the above description applies, and who wishes to be in a position to wear an armlet, should make arrangements to attest within the next few days. Attestation with the consequent right to wear the armlet will make it clear that the wearer has, while the voluntary system is still in force, shown his readiness to serve his country when called upon to do so.

The Medical Examination of Enrolled Medical Men.

Local arrangements will be made for the physical examination of all enrolled medical men. The Central Medical War Committee have accordingly been instructed that they, or the Local Committees, may arrange directly for the examinations to be carried out at the nearest recruiting board. Each candidate should be required to complete Army Form W. 3075, and in case of unfitness the reasons should be stated on the certificate. When the cause of unfitness is defective vision the degree of vision with and without glasses should be stated. The certificate and Army Form W. 3075 should be returned to the Local Committee, and will be forwarded by them to the Central Medical War Committee or Scottish Medical War Emergency Committee, who in turn will send these documents to the office of the Deputy Director of Medical Services.

Form W. 7.

We understand that in some quarters exception has been taken to the nature of the inquiries made on Form W. 7. This is a War Office form, and the questions that are put down for answer are the regular questions put to every applicant for a commission in any branch of His Majesty's forces.

THE POSITION OF MEDICAL STUDENTS.

An Army Council Instruction states that in consequence of the passing of the Military Service Act, 1916, the procedure to be followed in the case of medical students will be modified as follows:—

All medical students in their fourth or fifth years of study, and those in their third year of study whose examination takes place during the winter session must either

(i) attest under the Group System, or

(ii) become liable to the Military Service Act.

Procedure under (i).—Students who attest should produce a certificate signed by the Dean of the Faculty of their College to the effect that the student is enrolled in an Officers Training Corps and is—(*a*) a fourth- or fifth-year student, or (*b*) a third-year student to be examined during the winter session. These certificates will be attached to the document, and Army Book 414 endorsed: (*a*) "Fourth- (or fifth-) year student—not to be called up." (*b*) "Third-year student—postponed to 15th April, 1916." In the case of men in category (*b*), recruiting officers should on 15th April, 1916, ask the Dean of the College concerned the result of the examination; if the student has passed, Army Book 414 will then be endorsed "Not to be called up"; if he has failed he will be called up, provided that the group to which he belongs has been called up.

Procedure under (ii).—Students who do not attest must appeal to the Local Tribunal if they desire exemption. Certificate as in (i) should be attached to the claim, and Military Representatives should assent to such claims. On 15th April, 1916, Military Representatives should apply for the withdrawal of the exemption certificates of third-year students who have failed in their examination.

THE POSITION OF MEDICAL OFFICERS UNDER THE POOR-LAW AND LOCAL AUTHORITIES.

The Secretary of the Local Government Board has sent a circular letter to local authorities stating that it has become necessary to make provisional arrangements for enabling every medical man of suitable age (45 and under) who can be spared from civil employment without serious injury to the civil population, to place himself at the disposal of the authorities, and to be prepared, if required, to take a commission in the army or navy in the near future. The Board asks to be supplied with a list of doctors of military age who are employed in Poor-law and other institutions, classified as follows:—(1) Those who could be spared almost at once; (2) those who might be spared later; (3) those who cannot be spared.

The circular concludes: "The authorities are of course bound to make adequate provision for the needs of the sick poor under their care, but subject to this they will no doubt willingly allow medical men of military age who are in their service to join the forces."

THE WAR AND SCIENTIFIC EFFICIENCY.

The necessity of maintaining the scientific efficiency of the nation is being increasingly recognised on all hands by thoughtful people. Professor E. B. Poulton, in his Galton lecture before the Eugenics Education Society last week, insisted on the necessity of changing the character of the examination for the Civil Service posts and for the army, so as to give to science a far more important place than it has held hitherto. Such a change, he thinks, would at once react on our public schools and on the older universities, bringing the members of future parliaments under the influence of science.

Such a demand is no new one, having been made by Huxley half a century ago, and Professor Poulton contrasts the country as it now is with the England which would have been if Huxley's advice had then been listened to. The same thought is in the mind of the faculty of the Imperial College in presenting a memorial to the governors reminding them that the College by its charter is directed to concentrate itself on science in its application to industry and to give the highest specialised instruction and provide the fullest equipment for the most advanced training and research. And both are entirely in harmony with the recent action of the Royal Society, which recognises that men specially versed in certain branches of science can be more usefully employed at home in work connected with the war. The Government, admitting the justice of this representation, has provided that analytical and research chemists shall not be called upon to serve in the forces without the consent of the Royal Society. Agricultural chemists, also, are covered by this regulation. A body of microscopists nominated by the Royal Society for protozoological and bacteriological work has been afforded protection, and no Local Tribunal will have power to enlist them without the authority of the Central Tribunal in London. In regard to other branches of science, the Board of Education is keeping in close touch with the Royal Society. These measures are an earnest of a fuller recognition of the value of scientific training and can hardly fail to command the approval of all who realise that the era of the triumph of mere physical force is passing.

VACANCIES FOR MEDICAL OFFICERS.—There are vacancies for medical officers in the 2nd London Sanitary Company, R.A.M.C. (T.F.). Applicants who have had some experience of public health work, or holding the D.P.H., will be preferred. There is a prospect of active service abroad after a brief period of training. Applications should be addressed to Captain Caley at the Duke of York's Headquarters, Chelsea.

THE WOUNDED ALLIES RELIEF COMMITTEE.—Mrs. A. H. Scott, who has just returned from a visit of inspection to the two military hospitals (see THE LANCET, 1915, ii., 204, 789, 999) at Dieppe and Limoges, reports that at the desire of the district chef de santé the number of beds in the Limoges hospital is being increased from 170 to 250. That the work of the committee continues to be appreciated by the French authorities is evident from the following extract from a letter written by the Ministre de Santé, M. Justin Godart: "Vos hôpitaux de Limoges et de Dieppe n'ont cessé, depuis leur fondation, par les soins du 'Wounded Allies Relief Committee,' de constituer, pour l'évacuation et le traitement de nos blessés, une ressource des plus précieuses. J'ajoute que j'ai été très heureux d'appendre par vous que le 'Wounded Allies Relief Committee' se propose de manifester bientôt sa généreuse activité par de nouvelles entreprises également destinées à améliorer la condition des blessés de nos armées. Vous pouvez être assurée, ainsi que vos collaborateurs, que vous trouverez toujours auprès de moi toutes les facilités utiles à la réalisation de ses initiatives, inspirées par la profonde sympathie qui unit nos deux pays."

A SWEDISH WAR HOSPITAL IN LONDON.—The proposition to establish a Swedish war hospital for wounded and disabled soldiers in London has rapidly materialised after receiving generous support, not only from Swedes in London, but also from Swedes at home, and lately also from many English friends of Sweden. A fully equipped hospital for 30 in-patients and a number of out-patients has been established at 16–18, Paddington-street, W., and was formally handed over to the War Office on Feb. 21st by Count Herman Wrangel, Swedish Minister in London, who is chairman of the General Committee. Count Wrangel said that since the beginning of the war it had been the wish of the Swedish colony in England to give expression to her sympathy with those who were suffering through the war. He begged English friends to see in it a token of Swedish sympathy and of sincere appreciation of the hospitality enjoyed by Swedes in Great Britain. Surgeon-General Russell, in accepting the hospital on behalf of the War Office, said that its work would tend to strengthen the bonds uniting the two nations. The medical staff is made up of Mr. F. Swinford Edwards and Mr. G. B. Mower White, as honorary consulting surgeons; Dr. A. J. Jex-Blake and Dr. J. F. Jennings, honorary consulting physicians; Dr. H. B. Grimsdale (honorary oculist), Mr. Harold S. Barwell (honorary aurist), and Mr. Harry Forsyth (honorory dental surgeon). Regular attendance will be given by Dr. Edg. Cyriax, Dr. A. Ryman, Dr. C. Swanberg, and Dr. M. Widegren, and Dr. K. Westman has been appointed resident medical officer.

RED CROSS WORK IN DUBLIN.—A public meeting in aid of the City of Dublin Branch of the British Red Cross Society was recently held in the Mansion House under the presidency of the Lord Mayor of Dublin. It was stated that 1726 students had attended first-aid and home nursing classes held under the auspices of the branch. The chief activity of the branch was devoted to the maintenance of the Dublin Castle Hospital. This hospital received its first patients in February, 1915, and since that date 1206 soldiers had been received. Only six cases were fatal.

OBITUARY OF THE WAR.

GEORGE DEWAR, M.B., CH.B. ABERD.,

LIEUTENANT, ROYAL ARMY MEDICAL CORPS.

Lieutenant G. Dewar, who was killed in action in France on Jan. 3rd at the age of 23, was the youngest son of the late Mr. David Dewar, of West Cults, Aberdeenshire. He was born at Cosie Brae, West Cults, educated at Gordon's College, Aberdeen, proceeding to the University in 1910, where he graduated with distinction in July, 1915, being also proficient in sports. He played in the Rugby football team and was captain of the cricket eleven, and also played golf for the University and cricket for his county. At the commencement of the war he mobilised with the Royal Army Medical Corps, and did training at Bedford, afterwards obtaining permission to complete his medical studies. Prior to being commissioned he held the post of assistant physician at the Aberdeen Royal Asylum. After being gazetted he underwent training at Sheffield, proceeding to France in the beginning of November, 1915. He met his death from shell fire while doing duty with the advanced section of the 48th Field Ambulance, after three months' service in the field. An Aberdeen friend writes of him: "Generous by disposition and of splendid physique, he was a man who will be greatly missed. Many a junior student has benefited by his kindly assistance and advice. He had many friends among the teaching staff of the medical school. His death removes one who gave promise of exceptional capability."

HUGH RAMSAY DUFF,

LIEUTENANT-COLONEL, CANADIAN ARMY MEDICAL CORPS.

IN Colonel Duff the Canadian Army Medical Service has lost the senior medical officer of its permanent force, a man devoted to duty, who showed a striking fearlessness when carrying out that duty in the field. Born Sept. 20th, 1857, he was granted a commission in the Canadian Militia in

1882. He served in the South African War from 1899 to 1901, first as medical officer to the Royal Canadian Dragoons, and later to the 2nd Canadian Mounted Rifles, gaining the Queen's Medal with four clasps. After the war he was for long stationed at Kingston, Ontario, as A.D.M.S. to No. 3 Divisional Area. On the outbreak of hostilities he was appointed A.D.M.S. of the mobilisation camp at Valcartier, Quebec, but a fall from his horse and its results prevented him from accompanying the troops overseas. Returning to his duties at Kingston, when No. 5 Canadian Stationary Hospital was organised in that city, he was appointed second in command and accompanied that unit to the Mediterranean. Here he worked actively until an attack of pneumonia proved itself fatal within three days. His death took place at the Abbursich Barracks Hospital, Cairo, on Feb. 8th.

Colonel Duff was a member of the Examining Board of the College of Physicians and Surgeons of the Province of Ontario. He leaves a wife, two sons, and a daughter.

Medical News.

UNIVERSITY OF BRISTOL.—At the Final Examination for the degrees of M.B., Ch.B., held recently the following candidates were successful:—

Oliver Charles Minty Davis, D.Sc., and Hilda Kate Ewins.

In Part I. (including Forensic Medicine and Toxicology).—Edwin Jennings Ball.

CENTRAL COUNCIL FOR DISTRICT NURSING IN LONDON.—The first annual report of the council was presented to the meeting held at the Offices of the Metropolitan Asylums Board, Victoria Embankment, on Feb. 25th, at 11 A.M. An important scheme for the district nursing of measles, German measles, and whooping-cough is appended to this report.

ROYAL MEDICAL BENEVOLENT FUND.—At the last meeting of the committee, held on Feb. 8th, 20 cases were considered and £170 10*s.* voted to 15 of the applicants. The following is a summary of the cases relieved:—

Widow, aged 73, of M.D. Dub. who practised in London and died in 1876. After her husband's death she settled in Brussels and took in paying guests and did well and was able to save. At the outbreak of war her house and contents were taken over by the enemy, and all her savings are in Belgian stocks which she cannot realise. Has been living with friends, but this cannot continue. Voted £9 in six monthly instalments.—Widow, aged 52, of M.R.C.S. Eng. who practised at Wolverton and died in 1912. Was left fairly well off, but has become penniless through the mismanagement by others of her affairs. Has tried to earn a little by taking in boarders, but not successfully. One son, aged 17 years, who only earns 5*s.* a week. At present in great financial trouble. Voted £12.—Daughter, aged 72, of M.R.C.S. Eng. who practised in London and died in 1872. Applicant managed to earn a living as a governess until a few years ago, when she became totally deaf and suffers from rheumatism. Only income a pension of £25 from the Governesses' Benevolent Institution. Voted £12 in 12 instalments.—Daughter, aged 32, of M.R.C.S. Eng. who practised at Wolverhampton, and died in 1884. Applicant has had continuous bad health for years. Only able to work a few hours a day and earns about 6*s.* per week by teaching typewriting and bookkeeping. Relieved eight times, £58. Voted £12 in 12 instalments.—Widow, aged 35, of M.R.C.S. Eng. who practised at Swansea and Liverpool, and died in 1914. Applicant is suffering from paralysis of the right side, and is quite unable to do anything. Has one child aged 7 years, whom the Guild are going to see if they can assist with respect to her education. Applicant lives with her mother who is not well off. Relieved once, £12. Voted £12 in 12 instalments.—Daughter, aged 59, of M.R.C.S. Eng. who practised at Battle and died in 1873. Applicant suffers from chronic rheumatism and defective eyesight, and quite unable to work, and is dependent on sister. Relieved 32 times, £254. Voted £12 in 12 instalments.—Daughter, aged 59, of M.R.C.S. Eng. who practised at Box, and died in 1894. Applicant lives with two sisters, and all have indifferent health. Receives a little help from friends and from another charity. Relieved eight times, £126. Voted £18 in 12 instalments.—Widow, aged 69, of M.R.C.S. Eng. who practised in London, and died in 1893. Applicant's health is very bad, and she has recently had an accident which left her lame. Has a house which she lets, but cannot get the rent from the tenant, so is in temporary difficulties. Relieved once, £10. Voted £12 in 12 instalments.—Widow, aged 68, of M.D. St. Andrews who practised at Kidderminster, and died in 1884. Before the war she managed fairly well by taking in lodgers, but recently has lost them all as they have joined the army, and recently she has been ill in bed. Relieved once, £10. Voted £12 in 12 instalments.—Daughter, aged 41, of M.R.C.S. Eng. who practised at Scarborough, and died in 1879. Applicant makes a little by occasional nursing, but has not been successful of late. Relieved 11 times, £107. Voted £10 in two instalments.—Widow, aged 67, of M.D. Lond. who practised at Hoxton, and died in 1897. Was left quite unprovided for at her husband's death with one daughter, who worked as a milliner, but is now without a post. Makes a little by letting her house furnished in the summer, but not sufficient to enable her to manage. Relieved five times, £60. Voted £10 in two instalments.—Widow, aged 66, of M.R.C.S. Eng. who practised in various places and died in 1903. Applicant has two children, both married, and only able to help very little. She is too old to do anything herself in consequence of indifferent health. Relieved 12 times, £142. Voted £12 in 12 instalments. Daughter, aged 54, of F.R.C.S. Eng. who practised in Bedfordshire and died in 1890. Applicant was left entirely unprovided for, and the state of her health prevents her from taking any permanent work. Relieved 10 times, £76. Voted £12 in 12 instalments.—Widow, aged 56, of L.R.C.S. Edin. who practised at Fulham and died in 1910. Applicant endeavours to earn a living by taking boarders, but has not been very successful, and her health has been very indifferent of late. Relieved three times, £25. Voted £12 in 12 instalments.

Subscriptions may be sent to the honorary treasurer, Dr. Samuel West, 11, Chandos-street, Cavendish-square, London, W.

MEDICAL SICKNESS AND ACCIDENT SOCIETY.—The usual monthly meeting of this society was held on Feb. 18th at 300, High Holborn, W.C., Dr. F. J. Allan being in the chair. The sickness experience for January was slightly in excess of the expectation which is usual at this time of the year, and is generally accounted for by the number of claims for influenza. At this meeting there was discussed the special report on all the chronic claimants now drawing sickness benefit. These now number 40, and the amount paid per annum is £2000. This is considered to be the most important work the society performs, as it is principally the sickness benefit received each week that enables them to maintain themselves and their families. The votes obtained in consequence of the annual subscription of £105 to Epsom College have also enabled members of the society, crippled in health and unable to earn their living, to obtain Foundation Scholarships for their sons. The balance sheets for the year were produced and showed that the total funds of the society are now £274,700 and the annual income is £37,000. It was resolved to place before the members at the annual meeting in March a proposed scheme of deferred annuities starting at age 65, with five options before that age. The details will be sent out with the annual report. All applications should be addressed to the secretary, Medical Sickness and Accident Society, 300, High Holborn, London, W.C.

Parliamentary Intelligence.

NOTES ON CURRENT TOPICS.

Resumption of Parliament.

A NEW session of Parliament began on Tuesday, Feb. 15th. The opening in the absence of the King was performed by Royal Commission, and the speech which His Majesty transmitted to Parliament was exclusively devoted to the war and to problems arising in connexion with it. Further sacrifices in men and money are demanded of the nation. Increased taxation is certain, but the methods by which it will be raised will not be disclosed until Mr. MCKENNA makes a Budget statement. All domestic legislation is at a standstill during the period of the war. Parliament has a heavy enough task in dealing with the urgent necessities of the moment, and no disposition exists to undertake any other issues even of a minor kind until the termination of the struggle on the continent of Europe.

Deaths from Starvation.

The House of Commons has ordered a return of the deaths in England and Wales in the year 1915 upon which a coroner's jury has returned a verdict of death from starvation or death accelerated by privation, together with observations furnished to the Local Government Board by boards of guardians with reference to cases included in the Return.

Royal Commission on Venereal Diseases.

The report of the Royal Commission on Venereal Diseases has been laid on the table of the House of Commons.

Medical Re-examination of Rejected Recruits.

Attention having been called in the House of Commons to the action of certain military authorities in summoning for medical re-examination men who have been previously rejected under the Derby scheme, Mr. TENNANT, the Under Secretary for War, has made a statement on the subject. It was clear, he said, from the terms of the Military Service Act, that persons rejected on medical grounds since August 14th were outside the scope of that Act. Compulsion was not to be applied to them.

HOUSE OF COMMONS.

THURSDAY, FEB. 17TH.

Hospital Accommodation at Shorncliffe.

Replying to Mr. BENNETT-GOLDNEY, Mr. TENNANT (Under-Secretary for War) said: The Moore Barracks at Shorncliffe have been temporarily converted into a hospital mainly to deal with minor cases of illness amongst Canadian and British troops quartered at Shorncliffe and the neighbourhood. There are in addition a fully equipped military hospital of 250 beds and a newly built hut hospital of 200 beds, both of which can be used for more serious cases. Recreation and living rooms are not provided in any hospital, but dining-rooms are allowed for about half the number of beds. No dining-room existed at Moore Barracks, but a drill hall was allotted for this purpose with the approval of the local military medical officers, both Canadian and British. Two stoves were first installed, and as these were found inadequate three more have since been added by the War Department, making five in all. The building, designed as a drill hall, necessarily lacks some of the comforts of an ordinary dining-room. No reports have been received at the Headquarters, Eastern Command, from the general at Shorncliffe or the medical officers concerned that the heating now provided was inadequate. I am asking for a special report on certain of the accommodation.

TUESDAY, FEB. 22ND.

Temporary Commissions in the R.A.M.C.

Mr. ELLIS DAVIES asked the Under Secretary for War whether it was the intention of the War Office that medical men now holding commissions in the Royal Army Medical Corps, being under 45 years of age and unfit for foreign service, should resign the same on the expiration of their present agreement of service.—Mr. TENNANT answered: Temporarily commissioned officers of the Royal Army Medical Corps under 45 years of age and unfit for foreign service are not permitted to retain their commissions after the period of service for which they are engaged has expired. No further commissions are being given to men under 45 years of age unless they are physically fit for active service. It is hoped by these methods to set free men who are physically capable of undertaking general military duties and who had hitherto been employed in war hospitals in this country or had been engaged in private practice.

Medical Examination of Recruits.

Mr. RENDALL asked the Under Secretary for War whether he was aware that the scales for payment to medical men for examining recruits (Southern Command Order 507, dated March 13th, 1915) set forth that for a whole day, defined as six working hours, and the examination of from 30 to 40 recruits the payment of £2 was ordered to be made; that in certain towns the doctors declined to examine more than 31 recruits per day, and for this work had been paid the full fee of £2; that in other places doctors worked from nine to 12 hours, and in one case 226 recruits were examined in 15 consecutive hours, yet for these long hours and far greater number of examinations only the same fee of £2 was being paid as for the examination of 31 patients; whether he was aware that there was dissatisfaction; and would he order the payment of £2 for each six hours work and get his medical advisers to put these matters on a business-like footing.—Mr. TENNANT said in reply: If a few recruits are examined in a day the fee is 2*s.* 6*d.* a recruit, and £2 is the payment for a full day's work. In view of the evil results of hurried examination it is not considered desirable to hold out to doctors pecuniary inducements to examine more than 30 or 40 recruits in one day. I am not aware that the profession is dissatisfied with these arrangements.

Third Western General Hospital.

Mr. HADYN JONES asked the Financial Secretary to the War Office what was the cost per patient bed per week of the Third Western General Hospital for 1915, what the medical staff consisted of, the amount paid as remuneration, and how many members of such staff carried on private practice.—Mr. FORSTER replied: I regret that the Army Accounts are not kept in such a form as to admit of arriving at the weekly cost of a hospital per bed. This hospital, which is an administrative unit composed of many different buildings, contains 2000 beds. It has a staff of some 32 medical officers who draw the army pay of their ranks, and of these 19 are local members of the profession to whom it is open to pursue private practice.

District Insurance Committees.

Mr. TYSON WILSON asked the representative of the National Insurance Commissioners whether it had been decided that the continuance of district insurance committees in the county of Lancashire was undesirable; and whether this decision applied to all district insurance committees in Great Britain and Ireland.—Mr. C. ROBERTS answered: The activities of District Insurance Committees have in many areas been suspended. The action taken, which is without prejudice to the future, has the strong support of the Insurance Committee for the county referred to in the question.

WEDNESDAY, FEB. 23RD.

Nerve-shaken Soldiers.

Mr. KING asked the Under Secretary for the Home Department whether any further facilities were being offered to the War Office by the Lunacy Commission for the accommodation and treatment of nerve-shaken soldiers; and whether the building of any new asylum or other lunatic institution was now either in progress or contemplation.—Mr. BRACE replied: I am informed that no further facilities are being offered through the Board of Control for the accommodation and treatment of nerve-shaken soldiers as no further accommodation can be spared. At the request of the War Office the completion of the New Hampshire Asylum at Park Prewett is being expedited with a view to its being equipped and staffed by the military authorities as a temporary war hospital.

Mr. KING also asked the honourable gentleman whether the Lunacy Board of Control had at present any supervision over the Maudsley County Asylum at Denmark Hill; and whether the asylum authorities were responsible for the treatment of nerve-shaken soldiers who, being still under the Army Act, were within the precincts of any lunatic institution.—Mr. BRACE answered: The Board of Control do not exercise supervision over any military hospitals. Visits that they have for many years paid to a special section of Netley Hospital and more recently to temporarily adapted hospitals for nerve-shaken soldiers—within which category Maudsley Hospital falls—have been made at the request of the military authorities. The responsibility for the treatment of the soldiers in question rests entirely with the military authorities and not with any asylum authorities.

Appointments.

Successful applicants for vacancies, Secretaries of Public Institutions, and others possessing information suitable for this column, are invited to forward to THE LANCET *Office, directed to the Sub-Editor, not later than 9 o'clock on the Thursday morning of each week, such information for gratuitous publication.*

CRONE, J. S., L.R.C.P. Irel., L.S.A., has been appointed Deputy Coroner for West Middlesex.

GATES, MABEL EMILY, M.D., B.S. Lond., has been appointed Honorary Medical Adviser to the Ernsborough House Home (for patients in the last stage of illness), Exeter.

LEONARD, T. J., M.D. Lond., has been appointed Certifying Surgeon under the Factory and Workshop Acts for the Glaslough District of the county of Monaghan.

SALMON, ARTHUR GUY, M.D., B.S. Lond., L.R.C.P., M.R.C.S., L.S.A., has been appointed Medical Officer for the Workhouse and No. 2 District by the Bodmin (Cornwall) Board of Guardians.

Vacancies.

For further information regarding each vacancy reference should be made to the advertisement (see Index).
When the application of a Belgian medical man would be considered the advertisers are requested to communicate with the Editor.

BOLTON INFIRMARY AND DISPENSARY.—Female Second House Surgeon. Salary £200 per annum, with apartments, board, and attendance.

BOURNEMOUTH, ROYAL VICTORIA AND WEST HANTS HOSPITAL.—House Surgeon for six months. Salary £150 per annum and extras with board, lodging, and washing.

BRADFORD, CITY OF.—Temporary Female Medical Officer. Salary 8 guineas per week.

BRIGHTON, ROYAL SUSSEX COUNTY HOSPITAL.—Junior House Surgeon, unmarried. Salary £80 per annum, with War Bonus at rate of £100 per annum, with board, residence, and laundry.

BRISTOL ROYAL INFIRMARY.—House Physicians and House Surgeons. Salary at rate of £120 per annum, with board, apartments, and laundry.

BRIXTON DISPENSARY, Water-lane, Brixton, S.W.—Locum Tenens Medical Officer. Salary £175 per annum, with house and attendance.

BURY INFIRMARY.—Junior House Surgeon. Salary £150 per annum, with board, residence, and washing.

CAMBRIDGESHIRE ASYLUM, Fulbourn, near Cambridge.—Junior Assistant Medical Officer, unmarried. Salary £200 per annum, with board, lodging, washing, and attendance.

CHARING CROSS HOSPITAL.—Medical and Surgical Registrar.

GUILDFORD, ROYAL SURREY COUNTY HOSPITAL.—House Surgeon. Salary £150 per annum, with board, residence, and laundry.

HALTON PARK, TRING, 3/2ND E.A.F. AMBULANCE.—Medical Officer. Pay allowances as in Regulars, also outfit, field kit allowance. Rank, pay, allowances of Captain after six months.

HAMPSTEAD GENERAL AND NORTH-WEST LONDON HOSPITAL, Haverstock Hill, N.W.—Three Anæsthetists. Salary £25 per annum.

HUDDERSFIELD ROYAL INFIRMARY.—Junior House Surgeon. Salary £100 per annum, with board, residence, and laundry.

ITALIAN HOSPITAL.—House Surgeon for six months. Salary £80 per annum, with board and residence.

KING EDWARD VII.'S HOSPITAL FOR OFFICERS, 9, Grosvenor-gardens, S.W.—Resident Medical Officer.

LEEDS PUBLIC DISPENSARY.—Female Resident Medical Officer. Salary £130 per annum, with board, residence, and laundry.
LONDON FEVER HOSPITAL, Liverpool-road, N.—Assistant Resident Medical Officer. Salary £200 per annum, with residence and board.
NORFOLK, HEMPTON, FAKENHAM, 1ST SOUTH MIDLAND MOUNTED BRIGADE.—Three Medical Officers for 2nd Line (Territorials).
NORTHAMPTON GENERAL HOSPITAL.—Two House Surgeons. Salary £150 per annum each, with apartments, board, washing, and attendance.
NORTHAMPTONSHIRE WAR HOSPITAL, Duston, Northampton.—Pathologist and Bacteriologist; also Radiographer. Salary £1 per day, with board, lodging, &c.
POPLAR BOARD OF GUARDIANS.—Medical Officer for Old Ford District. Salary £130 per annum.
QUEEN CHARLOTTE'S LYING-IN HOSPITAL, Marylebone-road, N.W.—Female Assistant Resident Medical Officer for four months. Salary at rate of £60 per annum, with board, residence, and washing.
QUEEN'S HOSPITAL FOR CHILDREN, Hackney-road, Bethnal Green, E.—House Surgeons for six months. Salary £100 per annum, with board, residence, and washing.
SALFORD POOR-LAW UNION INFIRMARY.—Resident Assistant Medical Officer, unmarried. Salary £300 per annum, with apartments, attendance, and rations.
SHEFFIELD ROYAL INFIRMARY.—House Surgeon. Salary £100 per annum, with board and residence.
SOUTH SHIELDS, INGHAM INFIRMARY AND SOUTH SHIELDS AND WESTOE DISPENSARY.—House Surgeon. Salary £150 per annum, with residence, board, and washing.
STOCKPORT UNION, STEPPING HILL HOSPITAL.—Resident Assistant Medical Officer. Salary £300 per annum, with apartments, rations, &c.
SUNDERLAND ROYAL INFIRMARY.—Female House Surgeon. Salary £150 per annum, with board, residence, and laundry.
UNIVERSITY OF LONDON.—External Examiners.
WOLVERHAMPTON AND MIDLAND COUNTIES EYE INFIRMARY.—House Surgeon. Salary £150 per annum, with apartments, board, and laundry.
WINDSOR, KING EDWARD VII. HOSPITAL.—House Surgeon.

Births, Marriages, and Deaths.

BIRTHS.

BAILEY.—On Feb. 15th, at St. Mary Abbott's-terrace, Kensington, the wife of Reginald J. Bailey, L.D.S. Eng., of a son.
BOWEN-JONES.—On Feb. 15th, at Walker-road, Cardiff, to the wife of Lieutenant J. Bowen Jones, R.A.M.C., a son.
DIXSON.—On Feb. 12th, at Woodhurst-road, Acton, W., the wife of Dr. C. F. Lyne Dixson, of a son (prematurely).
GILMOUR.—On Feb. 15th, at West Meon, Hants, to the wife of R. Withers Gilmour, M.B. Durh., a daughter.

MARRIAGES.

GREIG—SCRIMGEOUR.—On Feb. 16th, at Hemsby Parish Church, Staff-Surgeon Louis L. Greig, R.N., to Phyllis, second daughter of Mr. and Mrs. Walter Scrimgeour, of Hemsby Hall, Hemsby, Norfolk.
INGRAM—MACTAGGART.—On Feb. 19th, at St. Mary Abbot's, Kensington, Percy Cecil Parker Ingram, M.B. Lond., Captain, R.A.M.C. (T.F.), to Dorothy Fanny Mactaggart, daughter of Edmonds Massey, of the Stock Exchange, and widow of F. D. Mactaggart, of Singapore.
JEFFREY—PAGE-ROBERTS.—On Feb. 10th, at Strathfieldsaye, John Jeffrey, M.B., F.R.C.S. Edin., of Jedburgh, to Cicely Frederica, daughter of the Rev. F. Page-Roberts, M.A., Rector of Strathfieldsaye.
MALLAM—SOMERVILLE.—On Feb. 16th, at St. Benet's Church, Cambridge, Captain Dalton Mallam, R.A.M.C. (T.), to Jessie Muirhead Somerville, niece of Mr. and Mrs. Robert Store, of Peldon Lodge, Colchester.
STEVENSON—OWENS.—On Feb. 15th, at St. George's, Worthing, William Sinclair Stevenson, M.D. Edin., to Mary Dorothea, widow of George Bolster Owens, R.N.
THOMAS—COULDREY.—On Feb. 19th, Lieutenant Donald C. Thomas, R.A.M.C., to Norah Alice, daughter of John Henry Couldrey, of Portsmouth-road, Maida Vale.
VICKERS—WILLIAMS.—On Feb. 21st, at St. Nicholas Church, Chiswick, Lieutenant Harold Vickers, M.R.C.S., L.R.C.P., R.A.M.C. (T.), to Ida Rylands Williams, adopted daughter of D. Owen Jones, of Bangor, Carnarvonshire, North Wales.

DEATHS.

ALEXANDER.—On Feb. 9th, died of wounds in Mesopotamia, Alister Ralph Speirs Alexander, M.B., B.S. Lond., Captain, Indian Medical Service.
GOUGH.—On Feb. 16th, in France, Bernard Bradly Gough, Temporary Lieutenant, R.A.M.C., of Compton Martin, Somerset.
HEBERDEN.—On Jan. 23rd, George Alfred Heberden, D.S.O., M.R.C.S., L.R.C.P. Lond., in his 56th year.
HOUGHTON.—On Feb. 17th, in London, suddenly, of heart failure, Arthur Noel Houghton, M.B., Ch.B., M.R.C.S., L.R.C.P. Lond.
HUNT.—On Feb. 15th, at Arosa, Switzerland, George Bertram Hunt, M.D. Lond., aged 44 years.
MITCHELL.—On Feb. 15th, killed in action in France, Francis Sidney Mitchell, M.B. Dub., Lieutenant, R.A.M.C., aged 26 years.
TURNER.—On Feb. 15th, 1916, at 6, Eton-terrace, Edinburgh, after a short illness, Sir William Turner, K.C.B., F.R.S., Principal and Vice-Chancellor of the University of Edinburgh, in his 86th year. (No flowers by special request.)

N.B.—A fee of 2s. is charged for the Insertion of Notices of Births, Marriages, and Deaths.

Notes, Short Comments, and Answers to Correspondents.

MEDICAL MATTERS IN THE FEDERATED MALAY STATES.

Sir E. L. Brockman, K.C.M.G., Chief Secretary of the Federated Malay States (Perak, Selangor, Negri Sembilan, and Pahang), in his report for the year 1914 gives the latest available estimate of the population as 1,117,625. The number of births in 1914 was 27,978 and the deaths 39,003. Infantile mortality is estimated to be 197·85 per mille, there being 5514 deaths of infants under 1 year of age. Malaria, he adds, is without doubt the chief cause of infantile mortality. Of the total deaths recorded, 13,634, or 34·95 per cent., were due to malaria. Dysentery and diarrhœa were the causes of 5235 deaths, beri-beri accounted for 1223 deaths, pulmonary tuberculosis for 1665, and pneumonia for 1081. There was a somewhat severe outbreak of cholera in Perak, there being 506 cases and 230 deaths; in Selangor there were 57 cases and 53 deaths, but none in Negri Sembilan or Pahang.

Ankylostomiasis is receiving greater attention, and more careful investigation has shown that the disease is more prevalent than was suspected, though there is no reason to suppose that it is on the increase. There were 699 cases of leprosy under treatment in the asylums during the year.

The medical institutions maintained by the Governmen comprise 42 hospitals (17 in Perak, 13 in Selangor, 7 in Negri Sembilan, and 5 in Pahang), 9 gaol hospitals, 2 lunatic asylums, and 3 leper asylums. In addition there are a decrepit ward in Taiping and vagrant and Tai Wah wards in Selangor. The number of in-patients treated was 100,614 (a decrease of 46 as compared with 1913) and the number of out-patients was 276,175, of whom 45,662 were treated by travelling dispensaries. There are 59 estate hospitals in Perak, 58 in Selangor, 40 in Negri Sembilan, and 7 in Pahang—these hospitals serving 342 estates with a total population of 161,379, comprised chiefly of Indian and Chinese immigrants.

The Institute of Medical Research was engaged during the year in further research work connected with beri-beri and devoted considerable attention to leprosy. A preliminary inquiry was also undertaken as to the character of the bacilli commonly associated with dysentery in the Federated States. An inquiry was likewise conducted by Dr. A. J. Stanton, of the institute, into the cause of the serious outbreak of cholera in Kedah. The director of the institute devotes considerable space in his annual report to the various preparations which are supposed to accomplish the destruction of rats, which have been doing considerable damages, especially in the Bagan Datoh district of Perak, and he observes that it has been shown time and again that the various viruses in the conditions met with in actual practice will not produce the results claimed for them.[1] Very useful work is being done by the lady medical officers. Malays are, however, very conservative, and it will require much time and patience to make them understand the advantage of Western methods. The Negri Sembilan Malays appear to be more ready than those of other States to avail themselves of the services of the lady medical officers. A commencement has been made with the construction of small hospitals for women at Kuala Kangsar and Kuala Pilah.

There were during the year 73 prosecutions under the Deleterious Drugs Enactment for morphia injection. The great majority of cases were in Selangor. There is no reason to suppose that the use of morphia and other deleterious drugs has increased to any serious extent. Fifteen persons were killed in 1914 by tigers alone in Negri Sembilan. There were also killed by various animals 15 persons in Perak, 13 in Selangor, and 4 in Pahang.

WHO IS INSANE?

Dr. Stephen Smith, who has graduated in the faculty of Law as well as of Medicine, answers the question, "Who is Insane?" (New York: The Macmillan Company. 1916. Pp. 285. Price 2s. 6d. net) in a popular manner, and illustrates with a minimum of technicalities the illusive nature of insanity, its origin in the derangement of the functions of the brain cells, the extreme impressibility of these cells, and our power to increase or repress their activities. As Lunacy Commissioner Dr. Smith was able to effect reforms tending towards humaner treatment of the insane, and he has therefore a right to speak on these matters.

[1] THE LANCET, Feb. 12th, 1916, p. 383.

THE DISPOSAL OF HOUSE REFUSE.

IN a communication which we have received from Dr. W. T. Gardner, of Bournemouth, a number of useful suggestions appear in regard to the satisfactory disposal of house refuse. One aspect of this important question is, we think, often lost sight of. Is it necessary that there should be so much garbage? We feel certain that there is an appalling waste of food material committed by consigning the trimmings of vegetables and often of meats, especially the fatty meats and those with a thick rind to them, too lavishly to the dustbin or kitchen fire. The first lesson to be learnt, it seems to us, is to utilise more and more of the materials for food and reduce less and less the output of garbage. At present there is much so-called garbage which could be used as food if only the importance of economy could be impressed upon the kitchen staff. At present it is common to find that potato peelings, cabbage stumps, cut-off pieces of bread or toast, strained-off fat, meat trimmings which could with proper treatment be utilised as food, have been put in the dustbin or destroyed by fire. This wastage, we think, is the first thing that should be stopped, in which case, necessarily, the output of garbage would be considerably diminished, and the nuisance arising from it reduced. Dr. Gardner is of opinion that, with a little pressure brought to bear upon householders by our sanitary authorities, a great improvement in the house or local disposal of garbage would be effected. He rightly insists upon all combustible matter, which of course includes the refuse of an easily decomposable or putrefactive nature, being destroyed by fire, which, in his experience, can be very easily and effectively carried out. We agree with him that some education and enlightenment is urgently needed upon these points.

THE NEED FOR MEDICAL MISSIONARIES.

Feb. 13th to 20th, the London Missionary Society's Medical Mission Week, has been made the occasion of a special issue of *The Chronicle*, the organ of the society, which contains several articles illustrating the need for skilled surgery and medicine and for trained nursing in countries where civilisation is backward or where oriental prejudices hinder the work of bodily and spiritual healing. Mr. James Cantlie, who, as dean of the College of Medicine, Hong-Kong, had many opportunities of becoming familiar with native prejudices, endorses the plea for highly educated medical men and women having ability to deal successfully with the arguments of rulers and scholars who by their action necessarily influence the lower classes. Dr. Alice Hawker, of Jiaganj, makes an earnest appeal for medical women as missionaries, illustrating the need by showing the evil done by native midwives and the difficulties which arise owing to religious prejudices of Hindu women against male doctors. The price of *The Chronicle* is 1*d*. and the address of the society is 16, New Bridge-street, E.C.

LIFE ASSURANCE AND TOTAL ABSTINENCE.

IN the report of the Sceptre Life Association for the year 1915 it is stated that during the year 121 claims occurred in the general section and 76 in the temperance section. In the former case the deaths represented 95 per cent. of the "expected" number, in the latter case 52 per cent.

IN the Medical Diary, on p. 328 of THE LANCET of Feb. 5th, the name of M. D. Waller is given as joint author of a paper on the Consumption of Carbon, to be read before the Royal Society. The author indicated was Miss Mary D. Waller, B.Sc., lecturer on physics at the London School of Medicine for Women.

Harvey's Views on the Use of the Circulation of the Blood, by Dr. John G. Curtis (the subject of a leading article in THE LANCET of Feb. 19th) is published by the Columbia University Press of New York. Price 6*s*. 6*d*. net.

W. A. D., Mrs. C., and Others.—Inquiries in regard to the conditions of employment of women in military hospitals should be addressed to Mrs. Furse, Devonshire House, Piccadilly, London, W.

COMMUNICATIONS not noticed in our present issue will receive attention in our next.

The following magazines, journals, &c., have been received:—Modern Hospital, Proceedings of the Royal Society of Medicine, British Journal of Dental Science, Monographs of the Rockefeller Institute of Research (Torula Infection), Annales de Gynécologie et d'Obstétrique, Pediatrics, American Journal of Orthopedic Surgery, Medical Review of Reviews, American Journal of Obstetrics, Journal of Surgery, Bulletin of the Johns Hopkins Hospital, American Journal of Roentgenology, Office International d'Hygiène Publique Bulletin, Transactions of the Society of Tropical Medicine and Hygiene, Tropical Diseases Bulletin.

Medical Diary for the ensuing Week.

SOCIETIES.

ROYAL SOCIETY, Burlington House, London, W.

THURSDAY.—Papers:—Mr. J. B. Cohen, Mr. H. D. Dakin, Mr. M. Daufresne, and Mr. J. Kenyon: The Antiseptic Action of Substances of the Chloramine Group.—Mr. I. J. B. Sollas and Prof. W. J. Sollas: On the Structure of the Dicynodont Skull.—Mr. W. L. Balls: Analyses of Agricultural Yield. Part III., The Influence of Natural Environmental Factors upon the Yield of Egyptian Cotton (communicated by Dr. F. F. Blackman).—Mr. A. J. Ewart: On the Function of Chlorophyll, Carotin, and Xanthophyll (communicated by Prof. A. C. Seward).

ROYAL SOCIETY OF MEDICINE, 1, Wimpole-street, W.

MEETINGS OF SECTIONS.

Monday, Feb. 28th.

ODONTOLOGY (Hon. Secretaries—F. R. Smyth, F. N. Doubleday): at 5.30 P.M.

A *Debate* on "War Injuries of the Jaws and Face" will be opened by Mr. J. Lewin Payne, and an *Exhibition* of Dental Splints, Models, Radiograms, Photographs, and other Apparatus illustrating the same subject will be open from Tuesday, Feb. 22nd to Monday, Feb. 28th. The Exhibition will be open from 11 A.M. to 6.30 P.M. each day.

SURGERY.—The Section of Odontology cordially invite the members of the Section of Surgery to the Debate on "War Injuries of the Jaws and Face" on Monday, Feb. 28th, at 5.30 P.M.

Thursday, March 2nd.

BALNEOLOGY AND CLIMATOLOGY (Hon. Secretaries—Chas. W. Buckley, J. Campbell McClure): at 5.30 P.M.

Paper:

Dr. Clippingdale: The Thames Valley—Certain of its Natural and Medical Attributes.

Report of the Committee of the Council.

(At 7.15 P.M. the members will dine together at Pagani's Restaurant, Great Portland street, W., and members may bring guests. Members who wish to dine are requested to send their names to Dr. J. Campbell McClure, 59, Harley-street, W.)

Friday, March 3rd.

LARYNGOLOGY (Hon. Secretaries—Cecil Graham, Frank Rose): at 4 P.M.

Specimens:

Will be shown by Sir William Milligan, Mr. Thomas Guthrie, and Dr. Watson-Williams.

Cases will also be shown.

ANÆSTHETICS (Hon. Secretaries—F. E. Shipway, Ashley S. Daly): at 8.30 P.M.

Paper:

Captain G. Marshall, R.A.M.C.: The Choice of Anæsthetics at a Casualty Clearing Station.

Demonstrations:

Dr. Harold Low: An Apparatus for the Intra-tracheal Insufflation of Ether.

Dr. F. E. Shipway: An Apparatus for the Administration of Warm Anæsthetic Vapours.

WEST LONDON MEDICO-CHIRURGICAL SOCIETY, West London Hospital, Hammersmith-road, W.

FRIDAY.—8 P.M., Cases. 8.30 P.M., Paper:—Mr. J. G. Pardoe: Prostatitis, Acute and Chronic.

LECTURES, ADDRESSES, DEMONSTRATIONS, &c.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, Lincoln's Inn Fields, W.C.

MONDAY, WEDNESDAY, FRIDAY.—5 P.M., Arris and Gale Lecture:—Prof. F. Wood Jones: The Influence of the Arboreal Habit in the Evolution of Man.

ROYAL FACULTY OF PHYSICIANS AND SURGEONS, GLASGOW, Faculty Hall, 242, St. Vincent-street, Glasgow.

TUESDAY.—4.30 P.M., Dr. James Finlayson Lecture:—Prof. Dr. Weinberg: Gas gangrene.

POST-GRADUATE COLLEGE, West London Hospital, Hammersmith-road, W.

MONDAY.—2 P.M., Medical and Surgical Clinics. X Rays. Mr. Gray: Operations. Mr. B. Harman: Diseases of the Eye. Dr. Simson: Diseases of Women.

TUESDAY.—2 P.M., Medical and Surgical Clinics. X Rays. Mr. Addison: Operations. Dr. Banks Davis: Diseases of the Throat, Nose, and Ear. Dr. Pernet: Diseases of the Skin.

WEDNESDAY.—10 A.M., Dr. Saunders: Diseases of Children. Dr. Banks Davis: Operations of the Throat, Nose, and Ear. 2 P.M., Medical and Surgical Clinics. X Rays. Mr. Pardoe: Operations. Dr. Simson: Diseases of Women.

THURSDAY.—2 P.M., Medical and Surgical Clinics. X Rays. Mr. Gray: Operations. Mr. B. Harman: Diseases of the Eye.

FRIDAY.—10 A.M., Dr. Simson: Gynæcological Operations. 2 P.M., Medical and Surgical Clinics. X Rays. Mr. Addison: Operations. Dr. Banks Davis: Diseases of the Throat, Nose, and Ear. Dr. Pernet: Diseases of the Skin.

SATURDAY.—10 A.M., Dr. Saunders: Diseases of Children. Dr. Banks Davis Operations of the Throat, Nose, and Ear. Mr. B. Harman: Eye Operations. 2 P.M., Medical and Surgical Clinics. X Rays. Mr. Pardoe: Operations.

NORTH-EAST LONDON POST-GRADUATE COLLEGE, Prince of Wales's General Hospital, Tottenham, N.

MONDAY.—Clinics:—10.30 A.M., Surgical Out-patients (Mr. E. Gillespie). 2.30 P.M., Medical Out-patients (Dr. T. R. Whipham): Gynæcological Out-patients (Dr. Banister). 3 P.M., Medical In-patients (Dr. R. M. Leslie).

TUESDAY.—2.30 P.M., Surgical Operations (Mr. Carson). Clinics:—Medical Out-patients (Dr. A. G. Auld); Surgical Out-patients (Mr. Howell Evans); Nose, Throat, and Ear Out-patients (Mr. C. H. Hayton). Radiography (Dr. Metcalfe). 3.30 P.M., Medical In-patients (Dr. A. J. Whiting).

WEDNESDAY.—Clinics:—2.30 P.M., Throat Operations (Mr. C. H. Hayton). Children Out-patients (Dr. T. R. Whipham); Eye Out-patients (Mr. R. P. Brooks); Skin Out-patients (Dr. H. W. Barber). 5.30 P.M., Eye Operations (Mr. R. P. Brooks).

THURSDAY.—2.30 P.M., Gynæcological Operations (Dr. A. E. Giles). Clinics:—Medical Out-patients (Dr. A. J. Whiting); Surgical Out-patients (Mr. Carson); Radiography (Dr. Metcalfe). 3 P.M., Medical In-patients (Dr. R. M. Leslie).

FRIDAY.—2.30 P.M., Surgical Operations (Mr. Howell Evans). Clinics:—Medical Out-patients (Dr. A. G. Auld); Surgical Out-patients (Mr. R. Gillespie); Eye Out-patients (Mr. R. P. Brooks).

ST. JOHN'S HOSPITAL FOR DISEASES OF THE SKIN, 49, Leicester-square, W.C.

TUESDAY.—4 P.M., Dr. Kempster: X Rays—Lupus and Tuberculosis.

THE THROAT HOSPITAL, Golden-square, W.

MONDAY.—5.15 P.M., Special Demonstration of Selected Cases.

THURSDAY.—5.15 P.M., Clinical Lecture.

ROYAL INSTITUTION OF GREAT BRITAIN, Albemarle-street, Piccadilly, W.

TUESDAY.—3 P.M., Dr. E. J. Russell: The Plant and the Soil—Nature's Cycle. (Lecture I.)

For further particulars of the above Lectures, &c., see Advertisement Pages.

EDITORIAL NOTICES.

IT is most important that communications relating to the Editorial business of THE LANCET should be addressed *exclusively* "TO THE EDITOR," and not in any case to any gentleman who may be supposed to be connected with the Editorial staff. It is urgently necessary that attention should be given to this notice.

It is especially requested that early intelligence of local events having a medical interest, or which it is desirable to bring under the notice of the profession, may be sent direct to this office.

Lectures, original articles, and reports should be written on one side of the paper only, AND WHEN ACCOMPANIED BY BLOCKS IT IS REQUESTED THAT THE NAME OF THE AUTHOR, AND IF POSSIBLE OF THE ARTICLE, SHOULD BE WRITTEN ON THE BLOCKS TO FACILITATE IDENTIFICATION.

Letters, whether intended for insertion or for private information, must be authenticated by the names and addresses of their writers—not necessarily for publication.

We cannot prescribe or recommend practitioners.

Local papers containing reports or news paragraphs should be marked and addressed "To the Sub-Editor."

Letters relating to the publication, sale, and advertising departments of THE LANCET *should be addressed "To the Manager."*

We cannot undertake to return MSS. not used

MANAGER'S NOTICES.

THE INDEX TO THE LANCET.

THE Index and Title-page to Vol. II. of 1915 were given in THE LANCET of Dec. 25th, 1915.

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VOLUMES for the second half of the year 1915 are now ready. Bound in cloth, gilt lettered, price 16*s.*, carriage extra.

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The public are informed that on and after Saturday, November 6th, newspapers, magazines, books, and other printed publications (other than trade circulars) will not be sent forward to neutral European countries unless posted direct from the office of publishers or newsagents who have obtained permission from the War Office for this purpose. Persons desiring to send newspapers, &c., to neutral European countries should, therefore, give their orders for execution to publishers or newsagents who have obtained such permission.

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METEOROLOGICAL READINGS.

(Taken daily at 8.30 a.m. by Steward's Instruments.)

THE LANCET Office, Feb. 23rd, 1916.

Date.	Barometer reduced to Sea Level and 32° F.	Direction of Wind.	Rainfall.	Solar Radiation in Vacuo.	Maximum Temp. Shade.	Min. Temp.	Wet Bulb.	Dry Bulb.	Remarks
Feb. 17	29·590	W.	.	81	48	39	38	40	Cloudy
,, 18	29·710	S.W.	0·07	55	53	39	39	40	Raining
,, 19	29·666	W.	0·12	62	50	39	44	48	Cloudy
,, 20	30·160	N.	0·06	64	44	38	39	41	Fine
,, 21	30·130	E.	...	47	43	36	36	38	Overcast
,, 22	30·122	N.E.	...	69	40	35	34	36	Fine
,, 23	30·080	N.E.	...	59	38	35	34	36	Cloudy

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Letters, each with enclosure, are also acknowledged from—

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B.—Dr. C. W. Budden, Hoylake; Sir T. Lauder Brunton, Bart., Lond.; Messrs. Burt, Boulton, and Haywood, Lond.; Bedford County Hospital, Secretary of; Mr. N. P. Brown, Glasgow; Mr. McL. Bainbridge, Makerston; Bradford Corporation, Treasurer to the; Captain C. A. Baragar, C.A.M.C., Taplow; Brixton Dispensary, Lond., Secretary of; British Drug Houses, Lond., Secretary of; B B.

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COMMITTEE FOR THE INVESTIGATION OF ATMOSPHERIC POLLUTION

FIRST REPORT

(April, 1914, to March, 1915)

47, VICTORIA STREET,
WESTMINSTER, S.W.

THE movement for the systematic investigation of atmospheric pollution may be said to date from the conference of delegates of municipal authorities and others held in connexion with the Smoke Abatement Exhibition in 1912.

Before that conference, inquiries bearing in various ways upon the investigation had been conducted in London by THE LANCET, in Leeds by Professor J. B. Cohen, and in Glasgow by the Corporation, and elsewhere. It was felt that the time had arrived for the various efforts to be coördinated so that the information could be put in the form of results which would be reasonably comparable for the same place, from month to month, from season to season, from year to year, and for different places for the same periods. It is only in this way that the information can be effectively utilised as an index of present effort and a guide to future action.

A Committee was therefore appointed to "draw up details of a standard apparatus for the measurement of soot and dust and standard methods for its use."

For this line of development, precedent in various stages of completeness may be found in the registration of births, deaths, and marriages, the registration of the elements of the weather, and in many other forms of economic inquiry. It is, indeed, the established line of development for nearly all forms of inquiry connected with the science of demography.

The coördination of observation is the legitimate work of a Committee. The design of new apparatus and methods for carrying out any particular inquiry may properly be left to individual effort, but the selection of a method for the special work of comparison, the specification of common conditions, and the coördination of the results are essentially matters for coöperative action, and can only be carried out by a representative body. Indeed, in the case of inquiries of coöperative character, it is the function of a Committee to prevent the better from becoming the enemy of the good.

The Committee appointed by the conference of delegates has held several meetings in furtherance of its object. It has drawn up specifications of a standard collector or "pollution gauge" and of an appropriate method of analysing the products.

As originally appointed it had power to add to its numbers, and it now consists of the following:—

Mr. C. J. P. CAVE (Past President of the Royal Meteorological Society).

Mr. J. G. CLARK.

Professor J. B. COHEN, B.Sc., Ph.D., F.R.S. (Leeds University).

Dr. H. A. DES VŒUX (Hon. Treasurer, Coal Smoke Abatement Society).

Dr. HAWKESLEY (Assistant Medical Officer of Health, Liverpool).

Mr. J. B. C. KERSHAW, F.I.C. (Hamburg Smoke Abatement Society).

Dr. R. LESSING, F.C.S.

Dr. J. S. OWENS (Coal Smoke Abatement Society), *Honorary Secretary.*

Dr. E. J. RUSSELL, Director of the Rothamsted Experimental Station, Harpenden.

Sir NAPIER SHAW, Sc.D., LL.D., F.R.S. (Director Meteorological Office), *Chairman.*

Mr. E. D. SIMON (Smoke Abatement League of Great Britain).

Bailie W. SMITH (Convener of the Air Purification Sub-Committee of the Glasgow Corporation).

Mr. S. A. VASEY, F.I.C., F.C.S. (THE LANCET).

Mr. F. J. W. WHIPPLE (Superintendent of the Instruments Division, Meteorological Office).

The Committee met for the first time on June 21st, 1912, and since that time has held 12 meetings.

On the recommendation of a Sub-Committee, consisting of the Hon. Secretary, Mr. J. G. Clark, and Mr. Bailie Smith, it has approved the specification of a standard gauge for collecting the atmospheric impurity which falls on an exposed surface together with that which comes down with the rainfall. It has arranged for the manufacture of the gauge and has been successful in securing the coöperation of the authorities of 19 cities and towns by whom gauges have been installed and provision made for the analysis of the collected products. The first gauge was sent by the makers to London for approval, and after some modification the delivery of completed gauges began in February, 1914, and by April 1st, 1914, 12 gauges were in operation, and after the lapse of a year from that date the Committee is in a position to present a Report on the work accomplished.

The Committee has also had under consideration a filter designed by Dr. J. S. Owens for measuring the amount of solid pollution in the atmosphere from hour to hour. A number of observations have been obtained, but the discussion of the results is not yet complete.

In presenting the Report of a year's investigation into the nature and degree of atmospheric pollution in the British Isles, the Committee considers that it would be well to place on record those aspects of the question of atmospheric purity which were kept in view in planning the inquiry, and to give an account of certain preliminary experiments which were made.

Normal air may be regarded as consisting of a mixture of various gases in the following proportions:—

TABLE I.

Oxygen	20·94
Nitrogen	78·09
Argon	0·94
Carbon dioxide	0·03
Helium, krypton, neon, &c.	traces.
	100·00

In addition to these gases, there exists a quantity of water vapour, varying according to certain well-known physical conditions.

The term "pollution" in its widest sense may be regarded as applicable to anything that disturbs the above-described constitution of the air, but in the present investigation a more limited view was taken.

For instance, an excess of the watery constituent, represented by excessive rain or an abnormal quantity of carbonic acid, may be regarded as pollution; but these constituents need no further consideration here.

The Committee's interpretation of the term "pollution" relates to such matter, solid, liquid, or gaseous, as reaches the surface of the earth or falls upon the buildings, &c., either by its own gravity or with the assistance of falling rain.

Solid Pollution.

The atmosphere, as we know it from everyday experience, contains suspended solid matter which cannot be regarded as a normal part of its constitution. Its significance from the physiological point of view is realised when we remember that an adult human being inhales about 400 cubic feet of air per day. No doubt a large proportion of this suspended matter is arrested in the filtering mechanism of the respiratory organs, but investigation has shown that suspended matter of a gritty nature will sometimes bring about bronchial inflammation.

Much of the solid pollution consists of combustible sooty matter, and those who have had occasion to handle shrubs, trees, and other plants in or near towns are familiar with the sooty stains that are left on the hands. This constituent is the source of much trouble in towns, where it gives a distasteful murky appearance to works of art, delicate fabrics, buildings, &c. Mural paintings are frequently found seriously obscured by a deposit which has its origin in the pollution suspended in the air.

In order to ascertain the nature of the suspended pollution, a member of the Committee made a chemical analysis of the matter intercepted by the ventilator filters of a large institution in London. This matter existed in the air in the form of suspended particles and was arrested in the filters through which the air was compelled to pass before entering the rooms of the building.

The following constituents were found:—

TABLE II.

Sodium chloride	Trace.
Calcium carbonate	2·17 per cent.
Ferric oxide	2·44 ,,
Calcium sulphate	5·09 ,,
Alumina	8·34 ,,
Magnesium carbonate ...	0·33 ,,
Sand...	37·99 ,,
Carbon	35·48 ,,
Ammonium sulphate	5·77 ,,
Tar (extracted by CS_2) ...	1·49 ,,
Fibrous matter	0·95 ,,
	100·05 ,,

It will be observed that sand and carbon are approximately equal in amount and together represent about two-thirds of the total. The table may be taken as representing the sort of suspended pollution of the air which the Committee had in view.

The large proportion of free carbon in the suspended matter clearly explains the dirtying effects that are too obvious in our towns and cities; but, in addition, there are sulphates present, the effect of which on building stones is notorious. In the matter alluded to in the above analysis the sulphur takes the form of calcium sulphate, ammonium sulphate, and a very minute quantity of free sulphur, the latter probably having its origin in the oxidation of sulphuretted hydrogen evolved from the imperfect combustion of raw coal. (See Table IV.)

Prior to the commencement of the systematic investigation, a number of experiments were made to determine at their sources the chemical character of certain kinds of pollution.

The combustion of certain kinds of fuel is one of the sources of atmospheric pollution, and in this connexion the following analyses are interesting and useful in interpreting the data subsequently dealt with in this Report.

Soot has its origin in the imperfect combustion of bituminous fuel, such as coal or wood, and its nature and amount varies with the conditions under which the fuel is used. The following two partial analyses (made by a member of the Committee)

indicate the chemical character of this material, the two samples being obtained from widely different sources; but in each case the fire was of the domestic type, consuming bituminous coal:—

TABLE III.

	Sample No. 1.	Sample No. 2.
SO_3	6·2 per cent.	5·8 per cent.
H_2O	4·4 ,,	4·0 ,,
CaO	1·4 ,,	2·5 ,,
Fe_2O_3	2·2 ,,	2·5 ,,
Cl	7·7 ,,	7·9 ,,
Ether extract (tar)	28·6 ,,	17·7 ,,
NH_3 (combined)	4·7 ,,	3·8 ,,
Other constituents ...	44·8 ,,	55·8 ,,

While these two specimens present several points of similarity, there are some important differences, and it is well known that even more marked differences would be found if a larger number of specimens were examined, especially if samples from larger furnaces were included. That there should be differences is not surprising when we remember the complex character of coal—the complexity of its decomposition when used in a grate, and the variety of temperature conditions that exist in fire-grates when fresh coal is put on the fire.

The above analyses refer to that portion of the products evolved from a coal fire which clings to the walls of the chimneys, and which necessitates the periodical sweeping for its removal. The matter that passes through the chimney into the atmosphere in the form of smoke would be similar in its chemical character to the soot found attached to the walls of the chimney, except that there would be in addition a considerable quantity of noxious gases and vapours.

In a particular case the following constituents were found in the smoke passing through a chimney under which a domestic coal fire was burning:—

TABLE IV.

Formaldehyde...	3·94 parts per 100,000
Sulphuretted hydrogen	51·35 ,, ,, ,,
Carbonic oxide	1·55 ,, ,, ,,

Having regard to the large volume of air that usually passes through a coal-fire chimney, these proportions are significant. The first two ingredients would probably undergo oxidation in the air, especially in the presence of sunlight.

In addition to these three gaseous impurities, other gases, such as sulphur oxides and ammonia, together with carbonic acid, were present in very large quantities, but were not estimated.

Tables III. and IV. refer to coal burned in domestic grates, but there can be little doubt that similar results obtain when coal is imperfectly burned in steam boilers, either land or marine, or in works where coal is used for purposes other than steam-raising, as, for instance, in the manufacture of earthenware appliances, &c.

Although the sulphur oxides and the ammonia are described here as forming *gaseous* pollution, they are usually found in the combined state as ammonium sulphate, which is normally a soluble solid. The sulphur, however, seems to lose none of its destructive effect on buildings by this union; in fact, experiments which have been made for the Committee indicate that the sulphur oxides in union with the ammonia are even more destructive than when they are free. This seems to arise partly from the fact that the basic substances of certain building stones have a natural tendency to displace ammonia from its salts and unite themselves with the acid component; and partly from the fact that the soluble solid ammonium sulphate, in the presence of moisture, has a much greater penetrating and continuous effect upon building stones than would be the case with the gaseous sulphur oxides.

Stones which are largely composed of carbonates of lime and magnesia suffer seriously in this way. A reaction takes place between the ammonium sulphate and the carbonates of lime and magnesia, the latter being converted into sulphates, with the formation of ammonium carbonate. The formation of those substances causes the stone to disintegrate, the process of destruction being hastened by the action of rain.

VAPOROUS AND GASEOUS POLLUTION.

These have been alluded to to some extent in the notes on solid pollution.

The vapours to which the attention of the Committee has been given were the tarry hydrocarbons. This tarry matter attaches itself to the carbon particles and gives them very great adhesive power, so that when they have deposited on and attached themselves to building stones, plants, &c., they cannot be readily washed away by rain, as would be the case if the tar were not there.

The gaseous pollutions kept in mind by the Committee were the sulphur oxides and ammonia. Coal contains on the average about 1 per cent. of its weight of sulphur (say, 20 to 30 lb. for each ton of coal). Under conditions of perfect combustion this sulphur would be evolved as either di-oxide or tri-oxide of sulphur or both, but, as was illustrated in Table IV., if the combustion is not perfect, sulphuretted hydrogen appears—in fact, it is probably always safe to assume that when visible smoke is evolved from coal sulphuretted hydrogen accompanies it.

The Committee recognises that during recent years many thousands of smoke-producing coal fires have been supplanted by gas cooking and heating stoves, and, still more recently, the electric stove has been introduced. The products of combustion from a gas fire consist mainly of CO_2 and water vapour, together with a minute quantity of sulphur oxides. There is a total absence of those tarry and carbonaceous substances that are produced by the use of raw coal, and as the sulphur is so exceedingly small in amount the gaseous method of heating is comparatively innocuous. As regards heating capacity, a coal fire consuming 21 lb. of coal per day would be about equal to a gas fire consuming 200 cubic feet of gas per day, but whereas the coal would evolve about 1500 grains of sulphur in various forms, as well as the tar, carbon, &c., already alluded to, the gas would contribute only 50 to 60 grains of sulphur in the form of sulphur oxides. Electric stoves do not evolve products of combustion, and therefore their use also tends to a cleaner air.

Apart from the polluting effect of the 20 to 30 lb. of sulphur for each ton of coal consumed, it is regrettable that this valuable material should be wasted. Its total amount must be huge. The Committee recognises that much of this waste of material is avoided when coal is utilised in the gasworks.

The preceding notes indicate briefly the aspects of the question of atmospheric pollution as it was approached by the Committee in the investigation now reported on.

METHODS OF WORK.

INTRODUCTORY.

The first duty of the Committee was to consider the method of investigation to be adopted. As in all such cases the choice of method is governed mainly by the object to be attained, so in the present instance it was necessary to define in exact terms what were to be the aims of the Committee.

The investigation of suspended impurity may be dealt with in one of two ways:—

(*a*) We may measure the amount deposited from the air in a given time and area.

(*b*) We may measure the amount suspended in the air at any given time and place.

These aspects of the question have each their own special interest and importance; for example, the deposited matter is that which chiefly affects our buildings and vegetation; while the suspended impurity is responsible for smoke, fogs, and obstruction of light, as well as for certain deleterious effects on the respiratory organs.

While the atmospheric impurity may be thus regarded from two distinct standpoints, there is no such natural line of demarcation as appears to be suggested into deposited and suspended matter, since all suspended matter is probably in the course of being deposited. This division may therefore be regarded as simply a convenient one made for the purpose of this investigation.

The method of measuring deposited impurity was capable of a simple and easy development, and hence it was decided to put this in operation first, leaving the measurement of suspended impurity until a suitable instrument could be devised.

It may be well now to review shortly the methods which have been or might be used for the purpose of measuring atmospheric impurities. The objects in view may be thus stated:—

(*a*) To measure the amount of matter deposited from the air on a given area at any place during a fixed period.

(*b*) To measure the amount of impurity held in suspension in the air at any time and place.

(*c*) To find the nature and composition of the deposited or suspended matter.

It will be convenient in what follows to refer to these objects by their letters (*a*), (*b*), or (*c*).

1. A measured volume of air may be filtered through cotton or asbestos wool and the weight of the deposit ascertained. This method was used by Dr. W. J. Russell for the Meteorological Office, and the details of his experiments are given in the Monthly Weather Reports for 1884–5; it has also been used since by different observers. In order to ascertain the weight of deposit on the filter the wool has to be very carefully dried and weighed before and after the air is drawn through, and it is in this part of the process that the greatest difficulties arise. It is by no means easy to get the wool dried to constant weight, and the amount of matter caught from the air by the filter is so small that large errors may be thus introduced. There is also the difficulty of obtaining a filter which removes all the suspended matter from the air. The method can, however, be used to obtain the amount of impurity, although it is not easy to find its nature owing to the difficulty in separating it from the filter. It may be said to fulfil condition (*b*) but not (*a*) or (*c*). In fact, no single method can fulfil both conditions (*a*) and (*b*); that is, measure the amount of deposited and suspended impurity.

2. All rain and deposited matter falling on a gauge vessel of known catchment area may be collected, the water evaporated or filtered, and the residue weighed and analysed. This method was used for an investigation conducted by THE LANCET during the years 1910 and 1911 into the soot-fall of London. The experiments were made under the auspices of The Coal Smoke Abatement Society and the analytical work was done in THE LANCET Laboratories under the direction of Mr. S. A. Vasey. The gauge used consisted of a vessel of 4 square feet catchment area, having a conical bottom so arranged that all rain falling in the gauge vessel was collected in bottles placed underneath. These bottles were removed at intervals of one month and their contents analysed. The gauge vessel was of enamelled sheet-iron, square in plan, and supported in a frame on four iron legs; it was surrounded by a cage of wire-netting open at the top to prevent birds from contaminating the deposit.

It was at first thought that the gauge might be fitted with a filter which would retain all the solid matter washed into it by the rain. For this purpose a glass vessel, 3 inches in diameter and 6 inches deep, terminating in a conical bottom with a small central opening, was fixed to the bottom of each gauge vessel; this was filled with fine glass wool tightly packed between two screens formed of nickel gauze with asbestos wool between. It was found, however, that this filter frequently showed a loss instead of a gain in weight after receiving a month's rainfall, probably due to the solubility of the glass wool. The method was therefore abandoned in favour of one in which all water and deposit were retained for examination. As modified in this way it has been adopted as the standard by the Committee and with certain alterations in the form and details of construction as indicated below has been that used by all authorities which are coöperating with the Committee, and the results of whose observations are embodied in the present Report. It will be noted that the method fulfils conditions (*a*) and (*c*).

3. *Aitken's Dust Counter.*—This is an ingenious instrument devised by Dr. John Aitken, F.R.S., and described fully in the Transactions of the Royal Society of Edinburgh, vols. xxx. to xxxvi. It is intended for counting the number of dust particles in the air, but no attempt is made to ascertain their composition. It is questionable whether the number of particles is a fair measure of the amount of impurity present, since this must depend also upon their size and composition. It would therefore appear that a small number of large particles may, according to this instrument, indicate a purer air than where a large number of smaller particles were present, whereas the amount of impurity may be greater in the former than in the latter case. According to Aitken, there are about 300 to 3000 dust particles in a cubic centimetre of country air from Argyllshire, whereas that of London contains 48,000 to 150,000 in the same volume of air. The method adopted is to cause the moisture in a small measured volume of air to be precipitated as rain on the glass slide of a small microscope, when the number of drops which fall can be counted. It is assumed that each drop has for its nucleus a dust particle. The method has the drawbacks above indicated, and does not seem to fulfil any of the conditions laid down above.

4. Glass plates may be exposed to the air for a known length of time, then washed in water and their opacity measured. This method was devised by Professor Cohen, of Leeds, and used there by him. It is primarily intended for measuring the amount of tarry soot which falls at a given place, since tar, or some sticky matter insoluble in water,

is necessary to enable the deposit to adhere to the plate when washed. The indication given provides a rough basis of comparison between the deposits at different places. It was not, however, regarded as fulfilling the conditions necessary for the purpose in view by the Committee. Briefly, the opacity of the plate must depend upon the stickiness of the deposit, not on its amount. Also it appears probable that during the period when the greatest amount of deposit reaches the ground—that is, during rain, the plate would be unable to retain it owing to its surface being wet.

5. A jet of air of standard size and velocity may be caused to strike a glass plate or a white paper placed at a fixed distance from the nozzle, and the opacity of the plate or discolouration of the paper measured after a definite time. The plate might be coated with some sticky substance, so that all the particles striking it adhere, and the method might be used in one of two ways:—

The air jet may be caused to play on the plate for a fixed time and the opacity measured by comparison with a specially prepared scale, or the jet may be made to play on the plate for such a time as will cause a fixed and predetermined opacity, the time required being compared with a calibrated time-scale. One of the advantages of such a method is that it would permit of making a complete measurement in a very short time. In cities where fogs are prevalent it is usual to find great variations in their density during short periods; hence it is essential that the time required for an observation should be as short as possible. This method does not seem, however, to give sufficient accuracy for the purpose required, especially as there would be no certainty that all the suspended particles in the air struck and adhered to the plate or paper.

6. A measured volume of air may be drawn through filter paper and the degree of discolouration produced on the paper compared with a calibrated scale. Or the air may be drawn through the paper until a predetermined degree of discolouration has been produced, the volume required being measured. The method has been tried in Glasgow with considerable success by Mr. Peter Fyfe. It was subsequently experimented with and developed by Dr. J. S. Owens with the object of devising a standard form of instrument. Such an instrument has now been in use for some time and enables a rapid measurement of the degree of pollution by suspended matter to be made. Briefly, it consists of two bottles used as aspirators, water allowed to syphon from one to the other draws a measured volume of air through a disc of filter paper of standard size, the discolouration of which is compared with a scale of shades. An observation can be taken in about ten minutes, and the instrument has been adopted by the Committee for the measurement of suspended impurity.

7. An optical method might be used by which the opacity of a column of air of a given length to a standard light is measured. This might be arranged to give quantitative results by preparing a scale of opacity from measurements taken with air containing known amounts of suspended matter, but the results would probably not be of great accuracy. The presence of water vapour would have to be guarded against in some way, also the indication given would depend rather on the power of the suspended matter to obstruct light than on the quantity present, since the size of the suspended particles would not be taken into account.

8. The rain might be caught and its opacity, after a thorough shaking, compared with a standard scale made by adding definite proportions of soot to distilled water. A method somewhat similar to this has been used for measuring smoke issuing from chimneys, but for our present purpose it is open to objection since it cannot be said to fulfil with accuracy any of the conditions laid down.

9. Boxes having a collecting surface of known area may be exposed for a definite time, their contents collected and analysed. The method was used by Mr. Peter Fyfe, Chief Sanitary Officer, Glasgow, with some success in that city. It is really a crude form of method No. 2 described above and does not call for further description in this connexion.

THE STANDARD GAUGE.

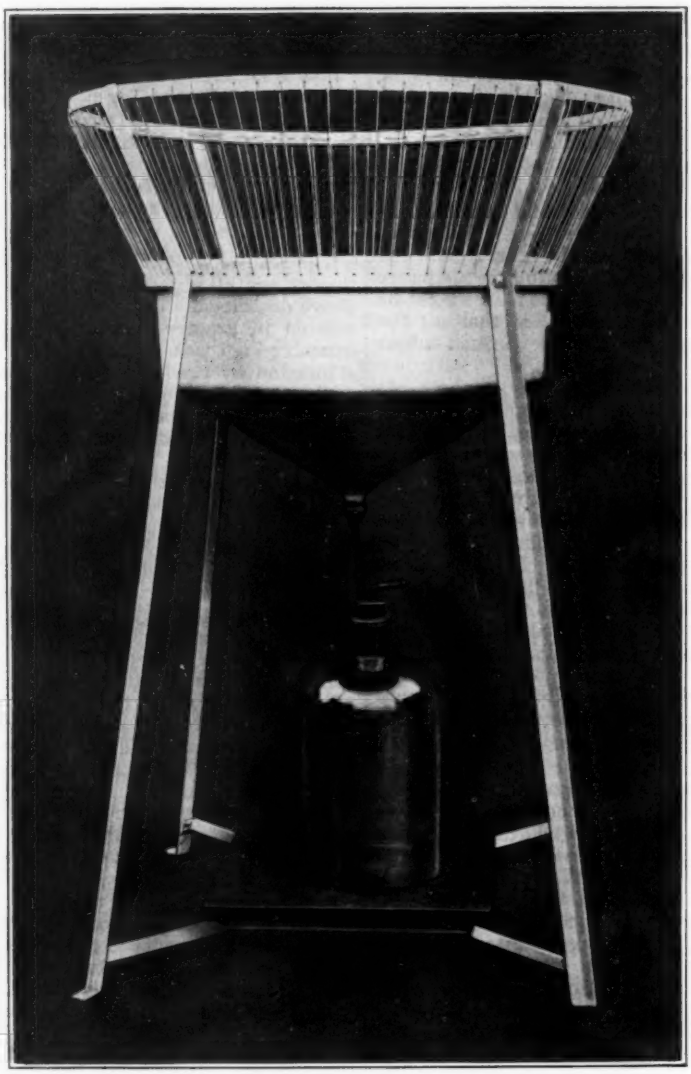
The results which are considered in the present Report are all obtained by the use of Method No. 2 above described. This may therefore be now considered in greater detail. The standard form of deposit gauge was the subject of very careful consideration by the Committee; provision had to be made to prevent contamination by bird-droppings and by matter from the gauge itself, also to prevent the access of dead leaves and other large wind-blown particles. It was necessary at the same time to obtain a fair and representative sample of the matter deposited in the neighbourhood. Great care had to be exercised that the gauges were not set up in such positions as to give fallacious results. The circular of instructions, a copy of which is given on page vi., was issued to each coöperating authority. This will explain the detailed construction and use of the standard gauge.

The question of the treatment of the water and solid impurities caught by the gauge was gone into most carefully. A Sub-Committee of skilled chemists was appointed to draft a standard method of analysis; this was printed and sent to each coöperating authority, and the analyses were carried out in most cases by the public analyst. The results were sent to the Committee monthly on a special form of report. The instructions for analysis are given on page vii. (Form A), also the blank form of report upon which the monthly returns were made by each coöperating authority (Form B).

Turning to the report Form B, it will be observed that under "gauge number" is given "Factor F for gauge." It was found that all the gauge vessels differed slightly in superficial area. They were intended to be 4 square feet in area, but owing to slight alterations in shape resulting from the process of enamelling with vitreous enamel, which had to be done after the gauge vessels were turned to size, and the consequent warping, it was necessary to measure the catchment area of each gauge separately. Again, although the analyst's figures were obtained in the first instance in grammes, it was decided by the Committee that the most suitable unit to use would be metric tons per square kilometre. A factor was therefore worked out for each gauge vessel which took into account the area of the vessel; this factor was called "F," and it enabled the grammes of deposit to be converted directly into metric tons per square kilometre by simple multiplication. Similarly, the volume of water in litres multiplied by the factor F gave the rainfall in millimetres. This factor, of course, differed for each gauge owing, as above pointed out, to slight differences in area, but it was usually equal to about 2·5.

The choice of "metric tons per square kilometre" as the unit for final comparison of figures was made by the Committee after careful consideration; it was influenced partly by the hope that the results would be of international as well as local interest.

THE STANDARD GAUGE



Height from ground to top of gauge vessel 4 feet.

DESCRIPTION OF STANDARD GAUGE.

The standard gauge, which is here illustrated, consists of a galvanised iron stand, supporting a circular enamelled iron gauge vessel of 4 square feet superficial area. Projecting above the gauge vessel is a wire screen open at the top, intended to prevent birds from settling on the edge of the vessel. The gauge vessel is conical at the bottom and communicates, by means of a glass tube and rubber connexion, with a group of three or more bottles connected together; designed to hold one month's rainfall. The rain and deposited matter falling on the gauge are collected in the bottles, and removed once a month for analysis.

INSTRUCTIONS FOR USE OF STANDARD GAUGE.

1. The gauges are to be placed, if possible, on the ground level in open spaces free from abnormal dust.
2. The bottles containing the water and deposit are to be removed on the last day of each month and replaced by thoroughly cleaned empty bottles.
3. Before removing the bottles the gauge vessel is to be washed down with some of the collected water, a brush and squeegee of standard pattern being used to remove any adherent matter.
4. A chemical analysis of the water and deposit is to be made by a standard method, details of which will be provided.
5. A report, on form provided, is to be sent monthly to the offices of the Committee, and a duplicate retained for reference.

FORM A.

COMMITTEE FOR INVESTIGATION OF ATMOSPHERIC POLLUTION.

INSTRUCTIONS FOR ANALYSIS OF RAIN WATER AND SOLIDS DEPOSITED IN THE STANDARD GAUGE.

1. The bottles, properly labelled with name and number of station and the period of collection, are to be kept standing at the laboratory for several days until completely settled. The approximate volume should be ascertained at the time of receipt.

UNDISSOLVED MATTER.

2. The whole of the amount collected should be used for estimating suspended undissolved matter.

Filtration.

3. The filtration is best done in the following manner. A syphon tube is inserted into the bottle to within about one inch of the bottom. The bottle should stand at a height above the vessel in which the filtrate is to be collected, sufficient for an easy and adjustable discharge of the liquid. The filtering medium which has given the best results consists of a layer of pulped filter paper, suitably disposed in a Gooch crucible. The Gooch crucible should be fitted, by means of an adapter, in the top of a graduated bottle of at least the same capacity as the station bottle. The stopper of the bottle is to be provided with another tube leading to a vacuum pump. The filter is prepared by weighing a 12·5 cm. filter paper or by tareing it against another paper of the same size, and heating this with about 200 c.c. of the collected water, which is separately syphoned over into a flask for this purpose. By violent shaking a very finely divided pulp is produced, and part of this is placed in the Gooch crucible. Gentle suction is then applied and the filter is ready for use. Should it get clogged up, the pulp, together with any solids collected, may be removed and kept for further treatment and a fresh lot of pulp used. After the clear part of the liquid has been filtered, the bottom turbid part may be shaken up and poured on, and the bottle washed out with some filtrate. Any paper pulp left over or previously removed is then put on top of the matter collected in the crucible. Should there be more than one station bottle, it is best to filter the clear liquid of all of them first, and then the part containing the solids which have settled on the bottom.

Total Undissolved Matter.

4. The Gooch crucible, after its contents have been washed with distilled water, is dried to constant weight; the difference from the empty crucible plus filter paper representing the total undissolved matter.

Tarry Matter.

5. The crucible is then placed in an extraction apparatus and contents extracted with carbon bi-sulphide. The difference found after drying represents the tarry matter.

Ash.

6. The residue from above is ignited for the determination of ash. Care must be taken that any particles which might possibly drop through the holes in the crucible bottom are not lost.

DISSOLVED MATTER.

Loss on Ignition and Ash.

7. 250 c.c. evaporated to dryness on water bath for total dissolved solids; residue gently ignited.

Loss: Organic matter soluble in water.
Residue: Soluble inorganic matter.

Sulphate.

8. One litre, concentrated, acidified with hydrochloric acid, boiled, barium chloride added, filtered, and barium sulphate weighed.

Chloride.

9. 500 c.c. titrated with N/10–$AgNO_3$ solution.

Ammonia.

10. One litre just acidified with dilute sulphuric acid and concentrated to 100 c.c. This after making decidedly alkaline distilled into N/10-acid and the ammonia calculated.

(Alternative: From 10 c.c. to 25 c.c. of the water with 1 c.c. Nessler reagent.)

Lime.

11. One litre to which solution of ammonia oxalate and a few drops of ammonia have been added to be concentrated to 100 c.c., the calcium oxalate to be filtered, dried, and gently ignited and weighed.

Alkalinity or Acidity.

12. 500 c.c., if alkaline, to be titrated with N/100 hydrochloric acid; if acid, with N/100 sodium hydroxide, using methyl orange as indicator; acidity to be calculated as H_2SO_4 and alkalinity as NH_3.

J. S. OWENS, Hon. Sec.,
47, Victoria Street, London, S.W.

NOTE.—After the experience gained in the year under review these instructions have been modified in some details.

FORM B.

No. of Report.....

COMMITTEE FOR THE INVESTIGATION OF ATMOSPHERIC POLLUTION.

REPORT OF OBSERVATIONS FOR MONTH ENDING .....19.....

Centre ..... (Gauge No. ..... / Factor "F" for gauge .....)

Collector .....

Volume of Water Collected.....litres = ... Millimetres of rainfall.

Total Solids dissolved .....grammes } dried @ 105° C.
Total Insoluble matter ..... " }

Total Solids Collected.....grammes=.....tons per sq. Kilometre.

	Grammes.	% of Total Solids.	Metric tons per square Kilometre.
COMPOSITION OF UNDISSOLVED MATTER:—			
Soluble in CS_2 (tarry matter)	.....	=.....%	.....
Combustible matter insoluble in CS_2	.....	=.....%	.....
Ash	.....	=.....%	.....
Total undissolved matter...			
COMPOSITION OF DISSOLVED MATTER:—			
Loss on ignition	.....	=.....%	.....
Ash	.....	=.....%	.....
Total dissolved matter...			
Sulphate as SO_4	.....	=.....%	.....
Chlorine as Cl	.....	=.....%	.....
Ammonia as NH_3	.....	=.....%	.....

REMARKS:—

Signed..... Date.....

TABLES OF RESULTS FOR THE YEAR ENDED MARCH 31, 1915, WITH MAPS SHOWING THE POSITIONS OF THE GAUGES.

Gauges have been set up as follows:—

Place.	No. of Gauges.	Correspondent.	Analyst.
Birmingham	3	Dr. J. ROBERTSON, M.O.H.	Mr. J. F. LIVERSEEGE, F.I.C.
Bolton	1	Dr. J. E. GOULD, M.O.H.	Mr. HARRY HURST, B.Sc., F.I.C.
Exeter	1	Mr. F. SOUTHERDEN	Mr. F. SOUTHERDEN, B.Sc., F.I.C.
Kingston-upon-Hull	1	Mr. A. R. TANKARD	Mr. A. R. TANKARD, F.I.C.
Liverpool	1	Dr. E. W. HOPE, M.O.H.	Mr. W. H. ROBERTS, M.Sc., F.I.C.
County of London	6	Mr. J. OLLIS, Chief Officer, Public Control Dept., L.C.C.	Mr. J. H. COSTE, F.I.C.
Meteorological Office, London	1	Director, Meteorological Office	Mr. S. A. VASEY, F.I.C., THE LANCET.
City of London	1	Dr. W. J. HOWARTH, M.O.H.	Mr. F. L. TEED, D.Sc.
Malvern	1	Mr. W. OSBORNE THORPE, Engineer, U.D.C.	Mr. C. C. DUNCAN, F.I.C.
Manchester	10	Mr. J. WARRINGTON, Secretary, Air Pollution Advisory Board	Mr. E. KNECHT, Ph.D., M.Sc.
Newcastle-upon-Tyne	1	Dr. H. KERR, M.O.H.	Mr. J. T. DUNN, D.Sc., F.I.C.
Oldham	1	Dr. J. B. WILKINSON, M.O.H.	—
Sheffield	4	Prof. W. P. WYNNE, The University	Prof. W. P. WYNNE.
York	1	Dr. E. M. SMITH, M.O.H.	Mr. S. H. DAVIES, M.Sc.
Coatbridge	1	Dr. A. G. DUTCH, Chief Sanitary Inspector	Messrs. R. R. TATLOCK and THOMPSON.
Greenock	1	Mr. J. DEVINE, Sanitary Inspector	Mr. J. W. BIGGART, F.I.C.
Leith	1	Mr. THOMAS BISHOP, Sanitary Inspector	Mr. A. SCOTT DODD, B.Sc., F.I.C.
Paisley	1	Mr. W. W. KELSO, Sanitary Inspector	Mr. R. M. CLARK, B.Sc.
Stirling	1	Mr. JOHN FYFE, Sanitary Inspector	Prof. J. R. WATSON.

The results obtained are set out in detail in the following tables. The gauges are on the ground level except where indicated.

BIRMINGHAM, CENTRAL (MAP I., p. ix.).

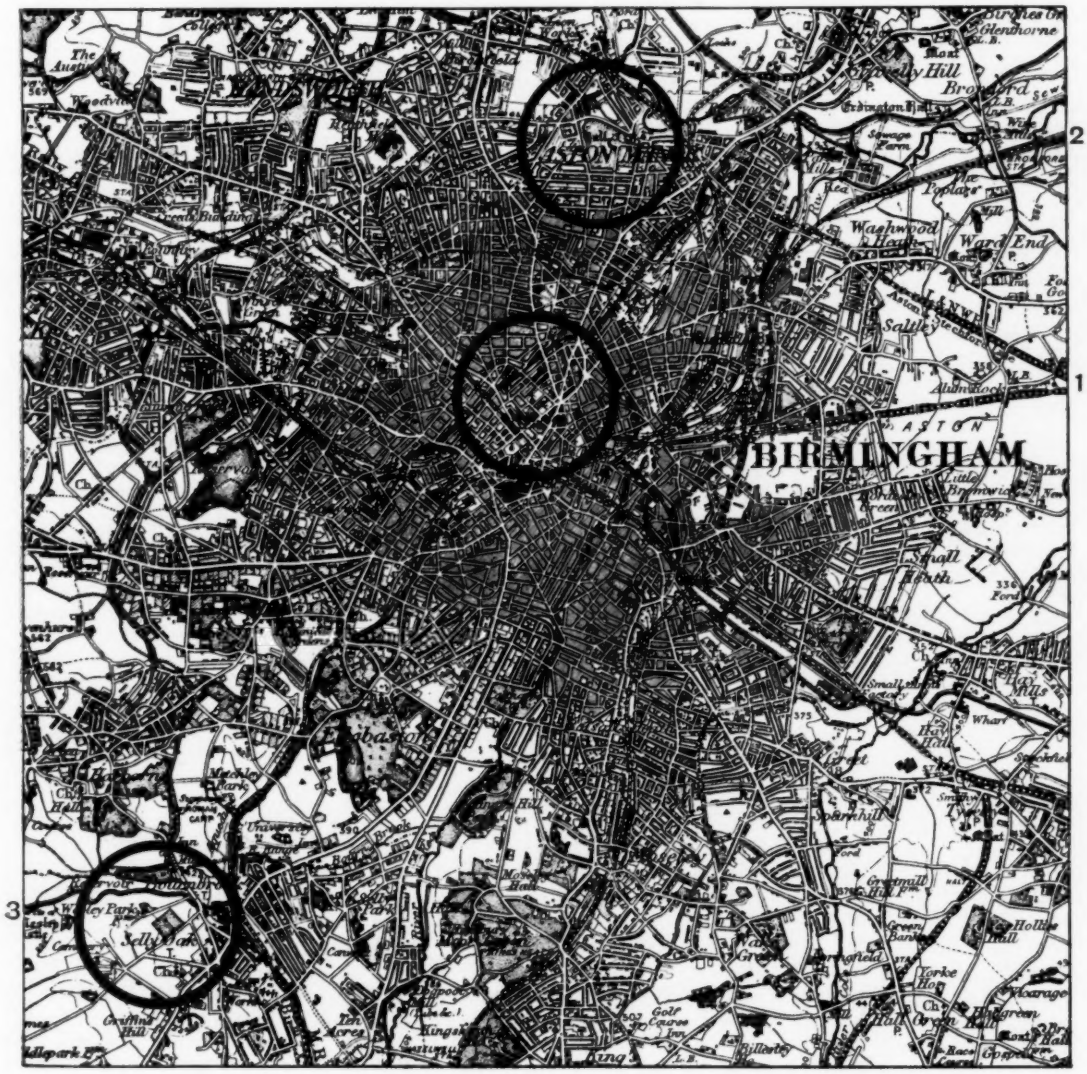
	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
1914.										
May	35·60	0·18	4·79	15·92	1·71	7·26	29·86	2·99	1·57	0·48
June	54·36	0·2	4·48	11·76	1·96	4·7	23·1	2·36	1·20	1·36
July	99·0	0·20	4·80	12·20	1·40	5·70	24·30	2·60	0·80	0·20
August	55·0	0·10	2·50	7·50	0·90	3·20	14·20	1·70	0·30	0·10
September	22	0·10	2·80	8·50	1·30	3·40	16·10	2·10	0·20	0·10
October	39	0·12	4·36	12·37	1·54	4·81	23·20	2·72	0·31	0·09
November	86	0·11	4·17	10·05	1·47	6·30	22·10	3·66	0·52	0·05
December	158	0·56	5·36	15·42	2·53	10·42	34·29	5·52	1·10	0·13
1915.										
January	72	0·15	5·29	13·16	2·70	7·00	28·30	4·40	0·60	0·04
February	89	0·19	3·04	7·57	1·60	5·80	18·20	3·60	0·60	0·07
March	20	0·12	3·90	12·38	1·30	4·20	21·90	2·60	0·40	0·03
Total	729·96	2·03	45·49	126·83	18·41	62·79	255·55	34·25	7·60	2·65
Monthly mean	66·36	0·18	4·14	11·53	1·67	5·71	23·23	3·11	0·69	0·24

MAPS OF DISTRICTS SHOWING THE POSITIONS OF THE STANDARD GAUGES.

(SCALE ONE INCH TO THE MILE.)

BIRMINGHAM—(1) CENTRAL, (2) ASTON, AND (3) SOUTH-WEST.

Map I.



BIRMINGHAM, ASTON (MAP I., p. ix.).

	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
1914.										
October	39	0·04	2·68	2·38	1·17	3·05	9·32	1·25	0·20	0·04
November	79	0·04	1·44	3·58	0·56	4·28	9·90	2·15	0·56	0·04
December	153	0·11	2·70	7·53	1·83	6·25	18·42	3·64	0·99	0·06
1915.										
January	67	0·08	1·11	3·43	1·10	4·00	9·70	2·00	0·40	0·04
February	83	0·09	2·55	7·76	1·40	4·80	16·60	3·10	0·40	0·04
March	18	0·10	1·12	3·68	0·80	2·80	8·50	1·70	0·20	0·02
Total	439	0·46	11·60	28·36	6·86	25·18	72·44	13·84	2·75	0·24
Monthly mean	73	0·07	1·93	4·73	1·14	4·19	12·07	2·31	0·46	0·04

BIRMINGHAM, S.W. (MAP I., p. ix.).

1914.										
October	42	0·04	0·89	1·86	0·83	2·08	5·70	0·91	0·19	0·03
November	78	0·02	0·65	1·34	0·47	2·35	4·83	0·96	0·43	0·03
December	185	0·06	0·92	2·39	0·56	4·17	8·10	1·68	0·93	0·02
1915.										
January	80	0·05	0·75	2·20	0·70	2·60	6·30	1·20	0·40	0·02
February	99	0·05	0·52	1·33	0·70	2·30	4·90	1·00	0·40	0·03
March	20	0·03	0·92	2·85	0·50	2·10	6·40	1·20	0·20	0·02
Total	504	0·25	4·65	11·97	3·76	15·60	36·23	6·95	2·55	0·15
Monthly mean	84	0·04	0·77	1·99	0·63	2·60	6·04	1·16	0·42	0·02

BOLTON (MAP II., p. xi.).

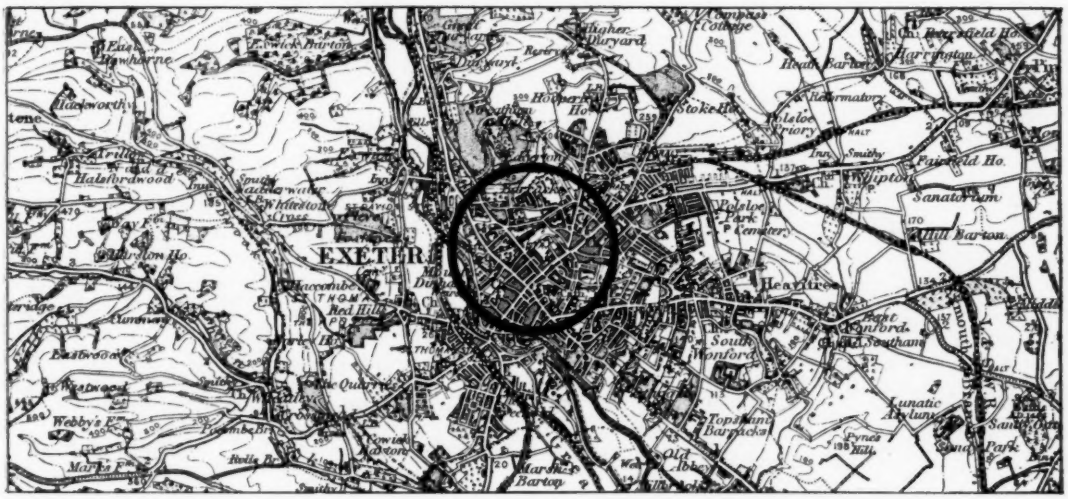
1914.										
July	135·0	0·09	2·16	4·75	5·43	5·43	17·86	3·35	1·19	0·06
August	89·0	0·20	2·94	6·15	2·49	6·41	18·02	3·66	0·49	0·06
September	126	0·08	2·02	7·54	7·07	7·57	24·28	4·05	1·88	0·09
October	72	0·21	1·85	7·52	3·17	8·34	21·10	4·73	0·92	0 05
November	156	0·10	1·77	3·89	7·12	14·25	27·13	8·46	2·63	0·14
December	171	0·10	2·89	8·88	4·77	11·59	28·23	6·47	3·24	0·15
1915.										
January	158	0·03	1·12	3·30	5·67	9·44	19·56	4·88	2·24	0·13
February	114	0·05	1·24	3·29	3·63	8·63	16·82	5·00	2·05	0·08
March	58	0·15	3·05	11·59	2·56	5·57	22·92	3·72	1·04	0·06
Total	1079·0	1·01	19·04	56·91	41·91	77·23	195·92	44·32	15·68	0·82
Monthly mean	119·9	0·11	2·12	6·32	4·66	8·58	21·77	4·92	1·74	0·09

EXETER (MAP III., p. xi.).

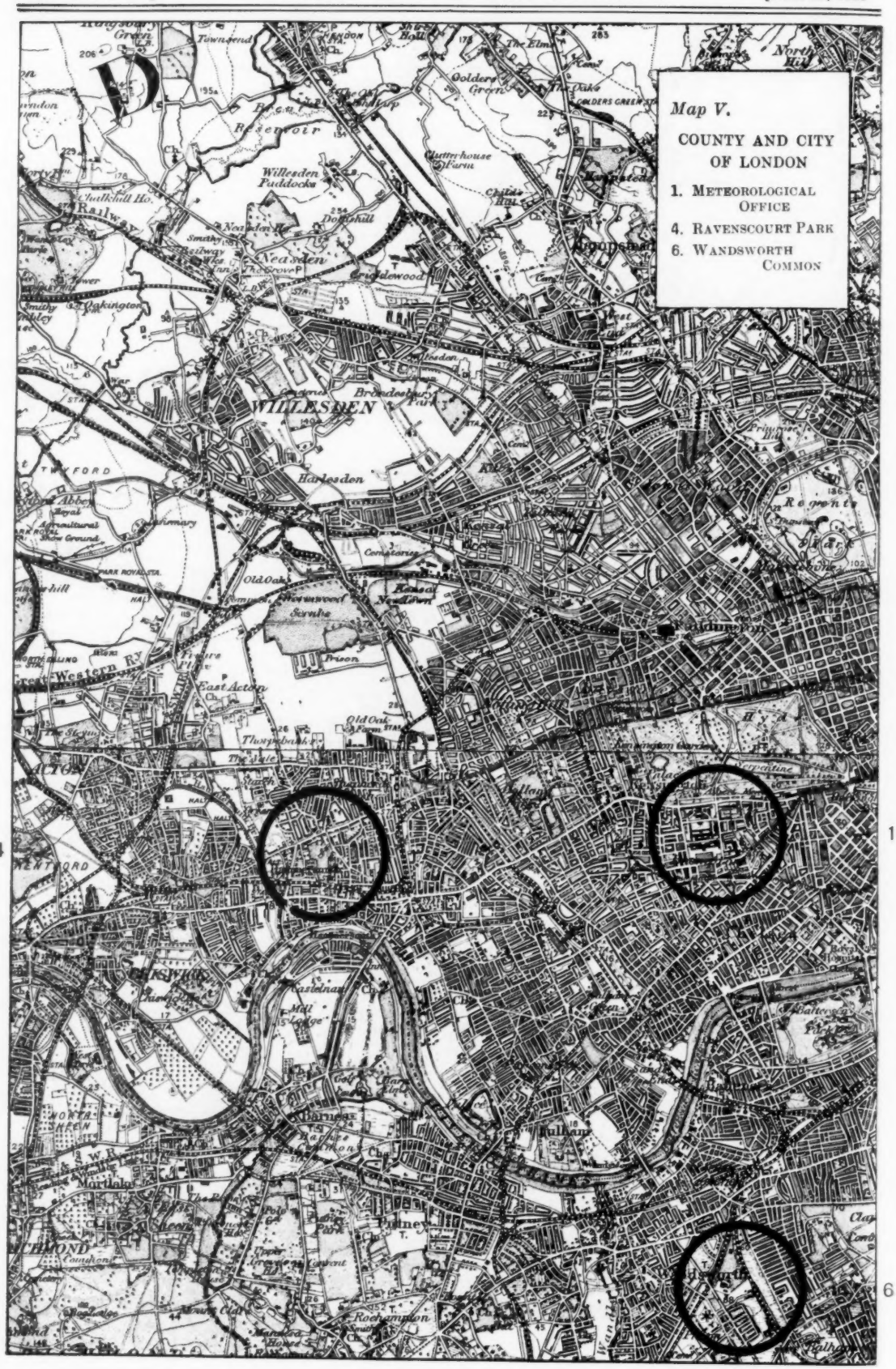
1914.										
April	32·30	0·04	2·05	4·71	0·97	1·61	9·38	0·74	0·29	0·02
May	41·80	0·05	2·37	3·56	0·79	1·97	8·74	0·77	0·31	0·00
June	32·50	0·07	1·78	2·83	0·83	1·04	6·55	0·45	0·098	0·00
July	85·0	0·05	1·76	3·42	1·50	1·70	8·42	0·75	0·30	0·00
August	59·0	0·03	1·08	2·25	0·91	1·95	6·21	0·79	0·12	0·01
September	65	0·04	1·62	3·20	0·78	1·98	7·63	0·74	0·39	0·00
October	34	0·04	1·37	3·22	0·68	1·41	6·73	0·76	0·27	0·01
November	81	0·03	1·21	2·12	1·94	3·75	9·06	1·67	0·65	0·04
December	185	0·05	1·42	2·59	2·96	7·71	14·73	2·83	1·86	0·06
1915.										
January	83	0·04	1·03	2·34	1·56	3·59	8·56	1·50	1·00	0·02
February	138	0·03	1·41	2·63	2·66	4·49	11·22	2·57	1·24	0·05
March	9	0·04	2·81	4·25	0·51	1·81	9·42	1·00	0·12	0·02
Total	845·60	0·51	19·91	37·12	16·09	33·01	106·65	14·57	6·648	0·23
Monthly mean	70·47	0·04	1·66	3·09	1·34	2·75	8·89	1·21	0·554	0·02

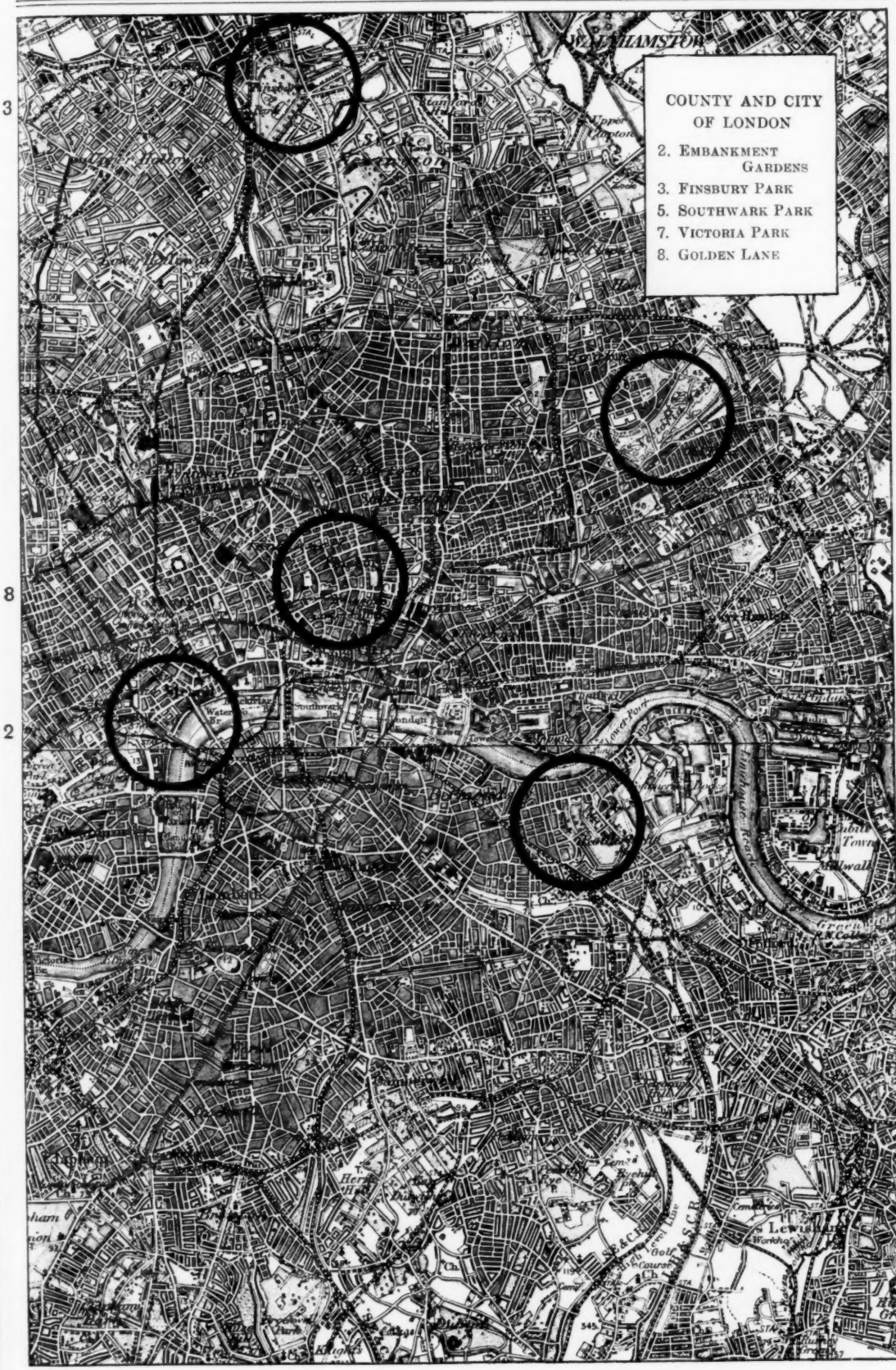
Map II. BOLTON.

Map III. EXETER.



Map IV. KINGSTON-UPON-HULL.


Map V.
COUNTY AND CITY OF LONDON
1. METEOROLOGICAL OFFICE
4. RAVENSCOURT PARK
6. WANDSWORTH COMMON
WILLESDEN
Harlesden
Neasden
Willesden Paddocks
Dollis Hill
Cricklewood
Brondesbury Park
Kilburn
Regent's
Old Oak
Wormwood Scrubs
Prison
East Acton
Western R.
Hammersmith
Fulham
Putney
Roehampton
Barnes
Mortlake
Richmond
Kew
Chiswick
Turnham Green
Goldhawk Road
Shepherd's Bush
Holland Park
Kensington Gardens
Hyde Park
Paddington
Golders Green
Hendon
Finchley
Hampstead
Highgate
North Hill
Child's Hill
Clitterhouse Farm
Oakington
Harrow Road
Old Oak Farm
Acton
Ealing
Hanwell
Brentford
Kew Gardens
Barnes Common
Putney Heath
Wandsworth
Battersea
Chelsea
Kensington
Notting Hill
Bayswater
Marylebone
Paddington
Kilburn
Willesden
Cricklewood
Neasden
Dollis Hill
Hendon
Golders Green
Hampstead
Highgate
Finchley
Acton
Ealing
Hanwell
Brentford
Chiswick
Richmond
Kew
Mortlake
Barnes
Putney
Roehampton
Fulham
Hammersmith
Shepherd's Bush
Holland Park
Kensington
Chelsea
Battersea
Wandsworth
Paddington
Marylebone
Regent's
Hyde Park
Kensington Gardens
Notting Hill
Bayswater
Harrow Road
Old Oak
Wormwood Scrubs
Prison
East Acton
Western R.
Willesden Paddocks
Dollis Hill
Cricklewood
Neasden
Brondesbury Park
Kilburn
Harlesden
Paddington
Marylebone
Regent's
Hyde Park
Kensington Gardens
Notting Hill
Bayswater
Chelsea
Kensington
Battersea
Wandsworth
Fulham
Hammersmith
Barnes
Putney
Roehampton
Mortlake
Richmond
Kew
Chiswick
Turnham Green
Goldhawk Road
Shepherd's Bush
Holland Park
Acton
Ealing
Hanwell
Brentford
Hendon
Golders Green
Hampstead
Highgate
Finchley
North Hill
Child's Hill
Clitterhouse Farm
Oakington
Harrow Road
Old Oak Farm


COUNTY AND CITY OF LONDON
2. EMBANKMENT GARDENS
3. FINSBURY PARK
5. SOUTHWARK PARK
7. VICTORIA PARK
8. GOLDEN LANE
3
7
8
2
1
5
6

KINGSTON-UPON-HULL (MAP IV., p. xi.).

	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Clorine (Cl).	Ammonia (NH_3).
1914.										
April	10·25	0·08	2·71	4·76	0·94	2·50	10·99	1·34	0·31	0·03
May	44·61	0·16	3·86	4·51	2·50	3·39	14·42	1·74	0·52	0·05
June	39·60	0·08	3·07	4·52	1·11	3·64	12·42	1·70	0·59	0·005
July	66·0	0·09	4·57	3·98	1·22	3·70	13·56	1·91	0·40	0·05
August	57·0	0·08	3·26	3·55	1·60	3·21	11·70	1·75	0·22	0·03
September	31	0·10	2·80	3·48	1·54	2·70	10·62	1·55	0·36	0·01
October	58	0·13	3·68	5·44	5·26	7·02	21·53	4·24	1·18	0·01
November	55	0·05	2·05	2·94	1·10	3·91	10·05	2·33	0·60	0·05
December	100	0·06	2·84	5·88	2·15	5·94	16·87	3·12	0·92	0·11
1915.										
January	64	0·08	2·34	4·18	2·69	4·22	13·51	2·90	0·48	0·08
February	79	0·05	2·02	4·13	2·53	5·07	13·80	2·61	0·76	0·07
March	31	0·08	2·23	4·85	1·95	4·20	13·31	2·45	0·43	0·04
Total	635·46	1·04	35·43	52·22	24·59	49·50	162·78	27·64	6·77	0·535
Monthly mean	52·95	0·09	2·95	4·35	2·05	4·12	13·56	2·30	0·56	0·045

LIVERPOOL (MAP VII., p. xx.

1914.										
April	22·23	0·36	2·18	8·01	2·40	3·02	15·97	1·93	0·61	0·13
May	56·14	0·16	4·11	8·96	2·47	4·94	20·64	3·37	0·72	0·22
June	38·02	0·46	2·26	8·93	1·37	3·27	16·29	2·07	0·35	0·16
July	103·0	2·55	2·37	9·41	4·72	5·34	24·39	3·63	0·95	0·31
August	58·0	0·08	1·63	6·52	2·68	4·90	15·81	2·86	0·37	0·24
September	81	0·16	3·02	7·30	5·49	3·88	19·86	2·93	1·49	0·21
October	52	0·19	2·28	9·50	3·13	3·87	18·97	3·03	0·59	0·17
November	79	0·24	3·22	6·85	3·15	4·41	17·87	3·57	1·34	0·21
December	125	0·40	2·61	9·84	5·99	3·75	22·59	4·11	1·77	0·23
1915.										
January	93	0·22	2·03	7·25	2·22	4·44	16·17	3·47	0·59	2·58
February	62	0·25	1·70	5·15	2·24	5·62	14·96	2·83	0·82	0·12
March	39	0·42	1·91	11·48	2·17	5·05	21·03	2·86	0·83	0·11
Total	808·39	5·49	29·32	99·20	38·03	52·49	224·55	36·66	10·43	4·69
Monthly mean	67·37	0·46	2·44	8·27	3·17	4·37	18·71	3·05	0·87	0·39

COUNTY OF LONDON, ROOF OF METEOROLOGICAL OFFICE (MAP V., pp. xii. and xiii.).

1914.										
April	18·70	0·05	2·43	5·63	1·87	2·61	12·59	1·46	0·98	0·11
May	35·20	0·05	1·57	2·96	0·00	2·11	6·69	1·14	0·82	0·21
June	35·00	0·08	1·84	5·81	3·22	2·53	13·53	1·73	0·60	0·06
July	38·0	0·02	0·77	2·74	2·58	1·68	7·81	1·57	0·40	0·07
August	28·0	0·03	1·69	2·27	1·33	3·46	8·80	1·72	0·40	0·02
September	21·0	0·05	1·97	1·92	1·28	1·94	7·16	1·21	0·45	0·05
October	26	0·08	0·61	1·70	2·13	2·98	7·52	1·62	0·54	0·02
November	74	0·14	1·68	4·29	3·89	5·36	15·30	2·98	1·21	0·11
December	114	0·19	1·25	4·58	6·36	6·48	18·86	4·10	1·44	0·11
1915.										
January	82	0·21	1·09	6·07	6·67	5·86	19·90	3·22	1·17	0·07
February	72	0·10	0·05	2·66	2·78	5·18	11·00	2·30	0·33	Traces.
March	16	0·13	0·32	7·01	1·66	4·00	13·00	1·62	0·82	0·03
Total	559·90	1·13	15·27	47·63	33·77	44·19	142·16	24·67	9·16	0·86
Monthly mean	47·66	0·09	1·27	3·97	2·81	3·68	11·85	2·06	0·76	0·07

COUNTY OF LONDON, EMBANKMENT GARDENS (MAP V., pp. xii. and xiii.).

Metric tons per square kilometre.

—	Rainfall in millimetres.	Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
1914.										
April	15·61	0·27	5·38	6·31	0·72	3·03	15·71	1·40	0·39	0·04
May	21·47	0·61	7·18	6·51	0·86	2·62	17·78	1·09	0·30	0·01
June	34·00	0·24	4·52	7·31	0·90	3·31	16·28	1·38	0·32	0·07
July	33·0	0·17	4·08	5·49	1·50	3·65	14·86	1·05	0·42	0·02
September	26	0·61	6·41	9·60	0·78	10·88	28·27	1·74	1·09	0·02
October	26	0·14	3·14	4·86	3·80	10·62	22·56	3·13	1·70	0·02
November	64	0·21	2·84	5·84	2·55	3·95	15·40	2·73	0·79	0·10
December	126	0·19	4·41	7·90	0·25	9·10	21·85	4·75	1·61	0·10
1915.										
January	90	0·14	3·18	6·42	0·71	8·08	18·55	4·47	0·95	0·07
February	74	0·50	4·16	10·70	2·07	8·45	25·88	3·42	1·92	0·08
March	17	0·23	2·63	8·12	1·69	4·36	17·03	2·41	0·84	0·08
Total	527·08	3·31	47·93	79·06	15·83	68·05	214·17	27·57	10·33	0·61
Monthly mean	47·92	0·30	4·36	7·19	1·44	6·19	19·47	2·51	0·94	0·06

COUNTY OF LONDON, FINSBURY PARK (MAP V., pp. xii. and xiii.).

1914.										
September	30·0	0·11	2·87	6·15	1·80	3·60	14·53	2·17	0·40	0·07
October	31	0·08	0·98	2·21	0·68	2·96	6·91	1·28	0·22	0·04
November	40	0·14	2·58	5·21	1·85	3·79	13·59	1·57	0·37	0·03
December	108	0·62	2·69	5·42	2·59	8·43	19·75	3·04	0·69	0·04
1915.										
January	107	0·14	1·68	3·18	2·56	4·69	12·25	3·12	0·68	0·15
February	78	0·12	1·52	4·92	0·31	5·77	12·64	2·37	0·66	0·03
March	25	0·12	1·08	4·61	0·74	2·57	9·12	1·57	0·21	0·03
Total	419·0	1·33	13·40	31·70	10·53	31·81	88·79	15·12	3·23	0·39
Monthly mean	59·8	0·19	1·91	4·53	1·50	4·54	12·68	2·16	0·46	0·05

COUNTY OF LONDON, RAVENSCOURT PARK (MAP V., pp. xii. and xiii.).

1914.										
September	22·0	0·01	0·55	1·47	0·26	1·10	3·39	0·43	0·30	0·03
October	22	0·03	0·78	1·46	0·57	1·51	4·35	0·74	0·25	0·06
November	51	0·10	1·13	2·84	1·01	2·73	7·81	1·33	0·39	0·07
December	150	0·01	1·58	4·23	0·90	7·51	14·23	3·21	0·32	0·07
1915.										
January	80	0·06	0·96	2·18	0·67	6·08	9·95	2·10	0·74	0·03
February	65	0·04	1·16	3·81	1·68	3·50	10·19	1·94	0·64	0·08
March	19	0·04	0·78	2·59	1·13	4·62	9·16	2·90	0·28	0·07
Total	409·0	0·29	6·94	18·58	6·22	27·05	59·08	12·65	2·92	0·41
Monthly mean	58·4	0·04	0·99	2·65	0·89	3·86	8·44	1·81	0·42	0·06

COUNTY OF LONDON, SOUTHWARK PARK (MAP V. pp. xii. and xiii.).

1914.										
September	19·0	0·05	3·27	6·73	0·32	3·26	13·63	1·67	0·37	0·05
October	31	0·02	3·98	6·48	1·07	5·33	16·88	2·93	0·47	0·06
November	69	0·06	2·86	5·17	1·51	5·77	15·37	2·99	0·63	0·08
December	152	0·22	4·47	7·84	3·33	12·14	28·00	5·55	1·18	0·17
1915.										
January	96	0·10	3·63	6·08	2·11	6·14	18·06	3·41	0·71	0·13
February	79	0·04	2·03	4·94	0·63	5·69	13·35	3·02	0·78	0·05
March	21	0·10	2·63	7·09	0·83	4·56	15·21	2·33	0·41	0·04
Total	467·0	0·59	22·87	44·33	9·80	42·89	120·50	21·90	4·55	0·58
Monthly mean	66·7	0·08	3·27	6·33	1·40	6·13	17·21	3·13	0·65	0·08

COUNTY OF LONDON, WANDSWORTH COMMON (MAP V., pp. xii. and xiii.).

	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
1914.										
September	10·0	0·02	0·54	1·31	1·25	2·76	5·88	1·50	0·41	0·01
October	29	0·03	1·64	3·16	0·70	3·45	8·98	1·76	0·37	0·03
November	42	0·08	0·36	1·04	0·41	2·57	4·49	1·37	0·29	0·02
December	127	0·05	1·47	4·03	1·02	10·18	16·75	5·13	0·81	0·08
1915.										
January	78	0·03	0·65	2·16	1·40	2·97	7·21	2·23	0·44	0·02
February	39	0·00	0·39	1·75	1·95	4·92	9·01	2·94	0·58	0·03
March	19	0·02	0·75	2·92	2·96	6·86	13·51	4·14	0·70	0·04
Total	344·0	0·23	5·80	16·37	9·69	33·71	65·83	19·07	3·60	0·23
Monthly mean	49·1	0·03	0·83	2·34	1·38	4·81	9·40	2·72	0·51	0·03

COUNTY OF LONDON, VICTORIA PARK (MAP V., pp. xii. and xiii.).

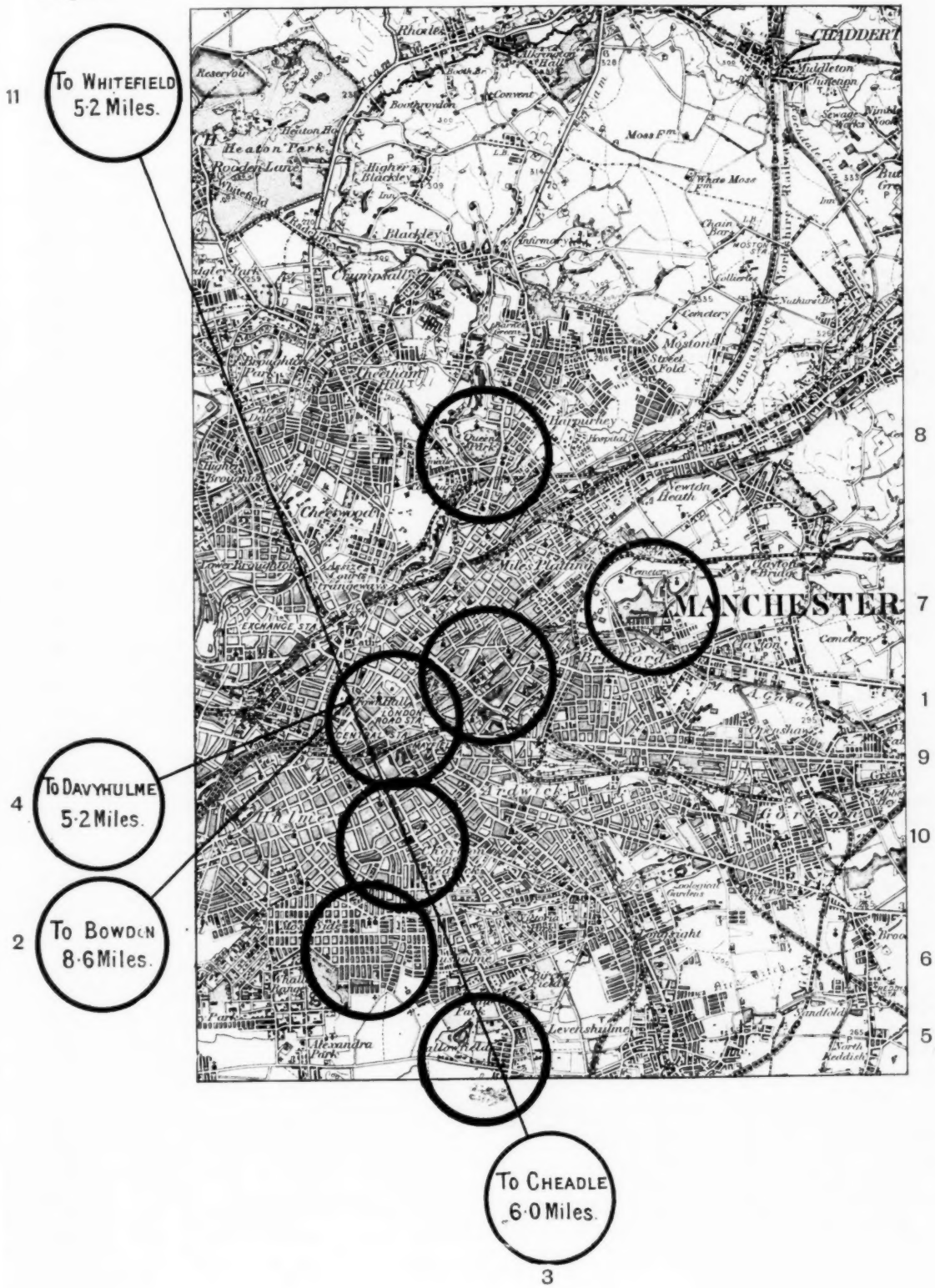
1914.										
September	30·0	0·05	0·99	2·29	2·49	6·61	12·44	3·60	0·73	0·04
October	19	0·06	1·23	1·96	1·56	4·56	9·37	2·05	0·28	0·05
November	42	0·04	0·92	1·76	1·25	4·49	8·46	2·65	0·31	0·04
December	149	0·05	1·33	2·91	1·79	6·89	12·97	3·41	0·95	0·08
1915.										
January	96	0·07	1·78	3·56	3·27	6·74	15·42	5·20	0·71	0·05
February	68	0·03	1·60	4·28	1·22	6·21	13·34	3·15	0·67	0·05
March	22	0·04	0·79	1·96	0·88	3·18	6·85	1·71	0·30	0·01
Total	426·0	0·34	8·64	18·72	12·46	38·68	78·85	21·77	3·95	0·32
Monthly mean	60·8	0·05	1·23	2·67	1·78	5·52	11·26	3·11	0·56	0·04

CITY OF LONDON, GOLDEN LANE (MAP V., pp. xii. and xiii.).
(56 feet above ground.)

1914.										
April	19·27	0·03	1·41	2·24	1·15	2·24	7·06	1·38	0·42	0·07
May	46·74	0·08	3·37	5·72	1·68	3·74	14·59	2·40	0·65	0·18
June	29·92	0·03	1·70	3·26	1·08	1·67	7·74	1·21	0·46	0·11
July	36·0	0·04	2·66	3·86	1·02	2·61	10·17	1·51	0·44	0·13
August	31·0	0·03	1·36	2·37	0·99	2·35	7·09	1·44	0·36	0·10
September	22·0	0·02	2·50	3·64	1·27	2·44	9·87	1·69	0·37	0·09
October	26	0·06	3·30	5·24	1·53	3·58	13·71	2·39	0·45	0·13
November	74	0·07	3·78	4·67	2·06	5·59	15·67	3·67	0·89	0·16
December	144	0·12	3·16	4·76	4·61	8·64	21·29	6·05	1·43	0·17
1915.										
January	94	0·07	2·46	3·83	2·36	4·51	13·12	3·64	0·73	0·10
February	80	0·08	3·04	5·21	3·54	7·08	18·94	4·74	1·26	0·19
March	18	0·06	3·49	6·68	1·39	3·35	14·96	2·22	0·51	0·08
Total	620·93	0·69	32·23	51·48	22·68	47·80	154·21	32·34	7·97	1·51
Monthly mean	51·74	0·06	2·69	4·29	1·89	3·98	12·85	2·69	0·66	0·13

MANCHESTER—(1) ANCOATS HOSPITAL, (2) BOWDON, (3) CHEADLE, (4) DAVYHULME, (5) FALLOWFIELD, (6) MOSS-SIDE, (7) PHILIPS PARK, (8) QUEEN'S PARK, (9) SCHOOL OF TECHNOLOGY, (10) UNIVERSITY, AND (11) WHITEFIELD.

Map VI.



MALVERN (MAP VIII., p. xx.).

	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine. (Cl).	Ammonia (NH_3).
1914.										
April	32·19	0·00	0·14	0·21	0·39	1·03	1·76	0·34	0·14	0·02
May	34·76	0·02	0·27	0·41	0·69	1·25	2·69	0·59	0·18	0·02
June	73·00	0·01	0·24	0·38	0·88	1·32	2·83	0·74	0·23	0·03
July	80·0	0·01	0·33	0·37	0·80	0·96	2·47	0·56	0·35	0·05
August	36·0	0·01	0·25	0·45	0·43	0·87	2·01	0·47	0·13	0·03
September	22·0	0·01	0·22	0·58	0·21	0·51	1·55	0·18	0·12	0·00
October	36	0·00	0·20	0·22	0·50	0·79	1·72	0·43	0·19	0·02
November	61	0·01	0·18	0·27	0·95	0·97	2·38	0·53	0·36	0·01
December	80	0·01	0·21	0·62	0·95	1·59	3·39	0·79	0·56	0·02
1915.										
January	64	Trace.	0·05	0·07	0·54	1·39	2·06	0·74	0·24	0·01
February	57	0·00	0·08	0·17	0·57	0·90	1·72	0·41	0·28	0·01
March	19	0·00	0·08	0·13	0·27	0·54	1·01	0·28	0·10	0·01
Total	594·95	0·08	2·25	3·88	7·18	12·12	25·59	6·06	2·88	0·23
Monthly mean	49·58	0·01	0·19	0·32	0·61	1·01	2·13	0·50	0·24	0·02

MANCHESTER. ANCOATS HOSPITAL (MAP VI., p. xvii.).

1915.										
January	128	0·08	4·82	12·23	2·25	11·21	30·59	6·59	1·53	0·11
February	71	0·11	3·65	9·40	1·82	7·83	22·81	4·33	1·09	0·08
March	34	0·15	4·95	13·08	1·77	7·03	26·98	4·17	0·76	0·06
Total	233	0·34	13·42	34·71	5·84	26·07	80·38	15·09	3·38	0·25
Monthly mean	77·7	0·11	4·47	11·57	1·95	8·69	26·79	5·03	1·13	0·08

MANCHESTER. BOWDON (MAP VI., p. xvii.).

1915.										
January	106	0·01	0·50	1·56	0·72	3·46	6·25	1·86	0·83	0·07
February	68	0·01	0·29	1·14	0·70	2·52	4·66	1·33	0·51	0·05
March	32	0·02	0·69	2·64	0·57	2·23	6·15	1·22	0·32	0·03
Total	206	0·04	1·48	5·34	1·99	8·21	17·06	4·41	1·66	0·15
Monthly mean	69	0·01	0·49	1·78	0·66	2·74	5·69	1·47	0·55	0·05

MANCHESTER, CHEADLE (MAP VI., p. xvii.).

1914.										
August	83·0	0·11	2·19	1·55	1·47	3·40	8·72	1·63	0·61	0·08
September	60·0	0·09	1·89	2·34	1·52	2·96	8·80	1·88	0·86	0·04
October	29	0·05	1·98	2·19	2·20	6·48	12·0	3·17	1·18	0·02
December	109	0·08	1·32	2·07	1·00	2·83	7·30	1·74	0·86	0·08
1915.										
January	109	0·06	2·29	3·62	1·08	3·58	10·63	2·22	0·84	0·06
February	53	0·06	0·95	2·53	1·03	2·04	6·61	1·35	0·60	0·05
March	33	0·06	2·14	3·95	0·53	2·68	9·36	1·53	0·34	0·05
Total	476·0	0·51	12·76	18·25	8·83	23·97	63·42	13·52	5·29	0·38
Monthly mean	68	0·07	1·82	2·61	1·26	3·42	9·06	1·93	0·75	0·05

November, 1914, frost.

MANCHESTER, DAVYHULME (MAP VI., p. xvii.).

	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
1914.										
August	64·0	0·02	0·81	0·82	0·56	2·06	4·26	1·38	0·28	0·06
September	64·0	0·04	1·16	3·18	1·73	3·50	9·61	2·38	0·95	0·10
October	39·0	0·02	1·41	4·69	0·51	4·12	10·75	2·61	0·35	0·08
December	121	0·04	0·95	3·19	1·45	6·00	11·63	3·37	1·17	0·13
1915.										
January	104	0·01	0·90	3·90	1·12	6·75	12·68	3·48	1·08	0·08
February	60	0·01	0·86	4·05	1·03	4·29	10·24	2·36	0·78	0·10
March	28	0·02	1·14	4·56	0·71	4·40	10·83	2·61	0·42	0·05
Total	480·0	0·16	7·23	24·39	7·11	31·12	70·00	18·19	5·03	0·60
Monthly mean	69	0·02	1·03	3·48	1·01	4·44	10·00	2·60	0·72	0·08

November, 1914, frost.

MANCHESTER, FALLOWFIELD (MAP VI., p. xvii.).

1914.										
August	89·0	0·02	0·73	1·05	0·78	2·02	4·60	1·44	0·31	0·05
September	67·0	0·05	1·36	3·06	0·94	3·05	8·46	2·03	0·73	0·05
October	38	0·06	1·50	4·78	0·91	4·25	11·50	2·53	0·51	0·04
December	108	0·08	1·19	3·75	1·13	5·76	11·91	3·00	0·89	0·06
1915.										
January	116	0·07	1·47	4·61	1·11	5·98	13·24	3·35	0·97	0·07
February	57	0·04	1·12	4·97	0·71	3·63	10·47	2·46	0·39	0·04
March	33	0·06	1·62	5·59	0·81	4·09	12·17	2·36	0·43	0·04
Total	508·0	0·38	8·99	27·81	6·39	28·78	72·35	17·17	4·23	0·35
Monthly mean	73	0·05	1·28	3·97	0·91	4·11	10·34	2·45	0·60	0·05

November, 1914, frost.

MANCHESTER, MOSS-SIDE (MAP VI., p. xvii.).

1915										
January	125	0·19	2·32	6·12	1·70	8·36	18·69	4·59	1·37	0·13
February	65	0·12	1·54	5·23	1·36	5·53	13·78	2·87	1·04	0·07
March	34	0·10	2·17	6·25	1·25	4·57	14·34	2·49	0·72	0·06
Total	224	0·41	6·03	17·60	4·31	18·46	46·81	9·95	3·13	0·26
Monthly mean	75	0·14	2·01	5·86	1·44	6·15	15·60	3·32	1·04	0·09

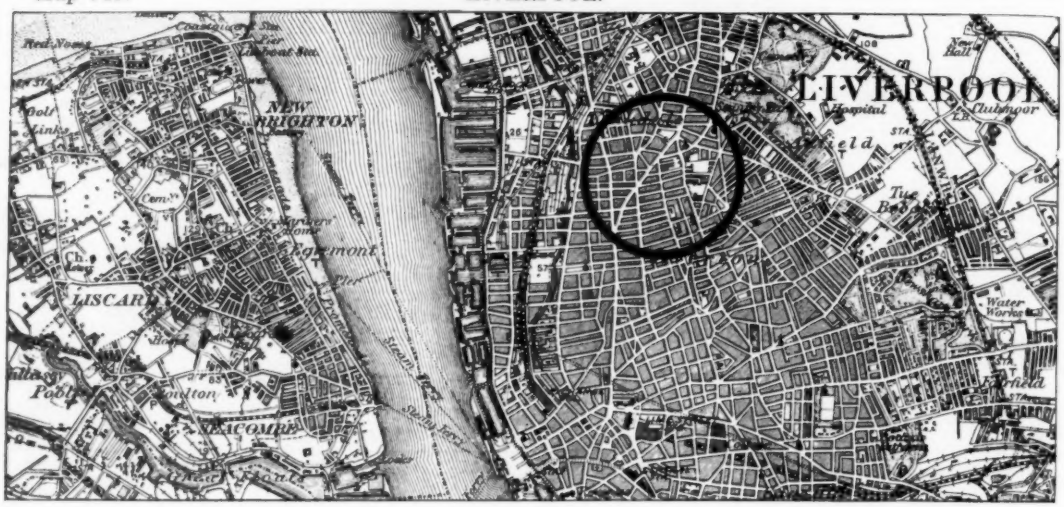
MANCHESTER, PHILIPS PARK (MAP VI., p. xvii.).

1915										
January	120	0·13	3·18	7·47	2·93	8·88	22·59	5·13	1·69	0·06
February	62	0·06	2·96	6·75	2·13	6·95	18·85	3·63	1·69	0·04
March	31	0·15	3·03	8·99	1·29	6·16	19·62	3·44	0·79	0·04
Total	213	0·34	9·17	23·21	6·35	21·99	61·06	12·20	4·17	0·14
Monthly mean	71	0·11	3·06	7·74	2·12	7·33	20·35	4·07	1·39	0·05

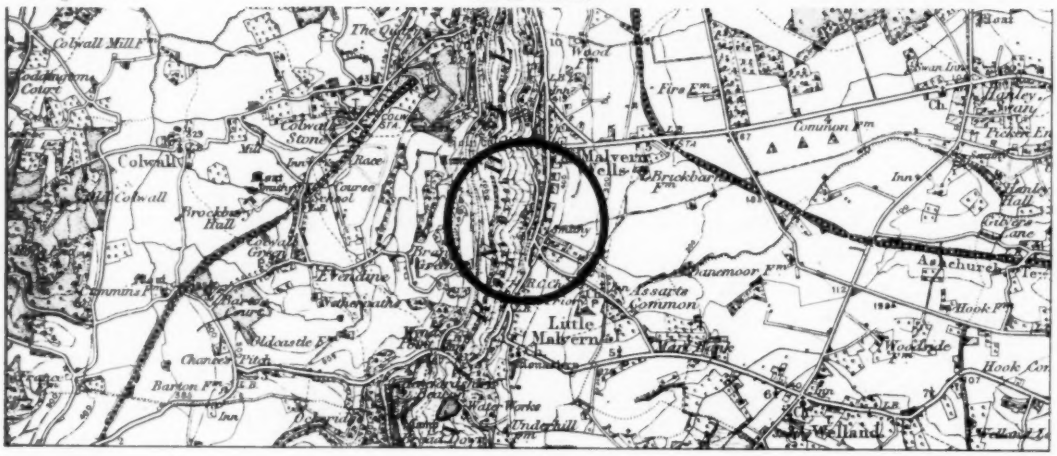
MANCHESTER, QUEEN'S PARK (MAP VI., p. xvii).

1915										
January	123	0·08	1·84	7·77	1·33	9·16	20·18	5·43	1·38	0·06
February	68	0·07	1·51	6·52	1·36	7·19	16·65	3·77	1·29	0·04
March	32	0·08	2·24	7·85	1·03	5·11	16·31	2·95	0·63	0·03
Total	223	0·23	5·59	22·14	3·72	21·46	53·14	12·15	3·30	0·13
Monthly mean	74	0·08	1·86	7·38	1·24	7·15	17·71	4·05	1·10	0·04

Map VII. LIVERPOOL.



Map VIII. MALVERN.



Map IX. NEWCASTLE-UPON-TYNE.

MANCHESTER, SCHOOL OF TECHNOLOGY (MAP VI., p. xvii.).

—	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
1914.										
July	105·0	0·15	4·47	9·20	2·77	7·74	24·33	3·87	2·03	0·15
August	79·0	0·07	3·23	5·96	1·31	3·76	14·33	2·31	0·64	0·07
September	73·0	0·10	3·34	6·63	1·63	4·92	16·62	3·39	1·09	0·09
October	42	0·12	5·04	9·12	1·26	4·41	19·95	2·94	0·52	0·06
November	91	0·14	3·69	6·16	1·27	6·40	17·66	3·77	1·38	0·10
December	117	0·15	2·03	2·88	1·45	6·26	12·77	3·46	1·41	0·10
1915.										
January	118	0·12	3·73	9·40	1·89	7·37	22·51	4·45	1·41	0·10
February	64	0·07	2·19	4·96	1·17	5·34	13·73	2·75	1·05	0·05
March	32	0·12	3·31	7·76	1·30	4·14	16·63	2·28	0·73	0·04
Total	721·0	1·04	31·03	62·07	14·05	50·34	158·53	29·22	10·26	0·76
Monthly mean	80	0·12	3·45	6·90	1·56	5·59	17·61	3·25	1·14	0·08

MANCHESTER, UNIVERSITY (MAP VI., p. xvii.).

1914.										
August	71·0	0·09	1·74	3·03	0·79	1·75	7·40	1·17	0·39	0·07
September	67·0	0·13	2·46	5·66	1·18	2·98	12·41	1·51	0·90	0·08
November	86	0·13	3·01	6·82	1·62	5·82	17·40	3·17	1·25	0·09
Total	224·0	0·35	7·21	15·51	3·59	10·55	37·21	5·85	2·54	0·24
Monthly mean	75	0·12	2·40	5·17	1·20	3·52	12·40	1·95	0·85	0·08

MANCHESTER, WHITEFIELD (MAP VI., p. xvii.).

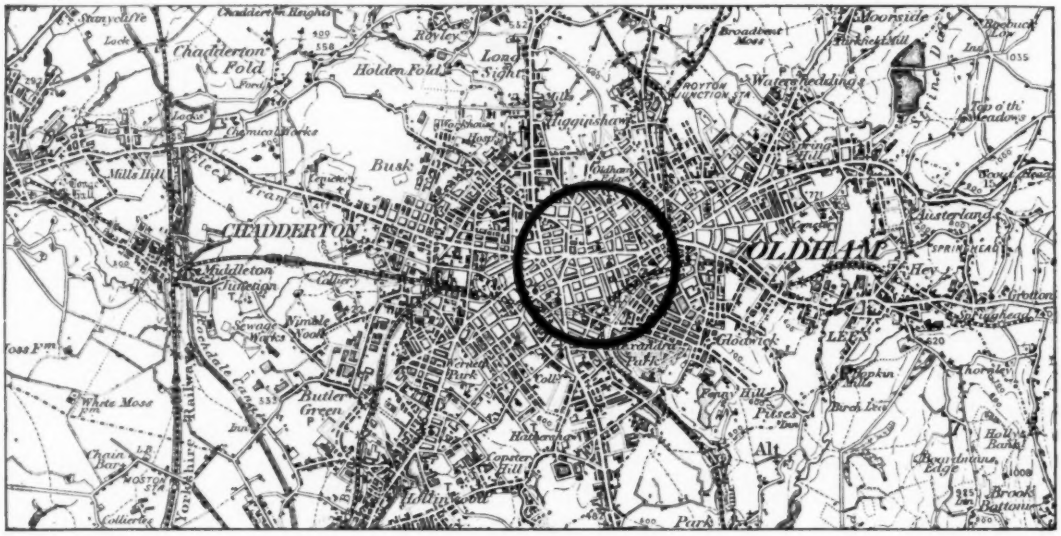
1914.										
August	101·0	0·05	1·28	1·89	0·98	4·47	8·66	2·52	0·47	0·06
September	76·0	0·03	1·60	4·69	1·72	4·99	13·03	2·75	1·07	0·05
October	56	0·03	1·36	4·83	0·59	5·77	12·58	3·32	0·39	0·04
December	133	0·06	1·56	5·51	3·67	10·20	21·00	5·14	3·43	1·85
1915.										
January	124	0·05	1·40	5·42	1·19	7·47	15·53	4·45	1·06	0·08
February	86	0·03	1·37	5·42	0·89	5·99	13·70	3·44	0·90	0·06
March	38	0·01	1·63	5·87	0·93	5·19	13·63	3·12	0·46	0·04
Total	614·0	0·26	10·20	33·63	9·97	44·08	98·13	24·74	7·78	2·18
Monthly mean	88	0·04	1·46	4·80	1·42	6·30	14·02	3·53	1·11	0·31

November, 1914, frost.

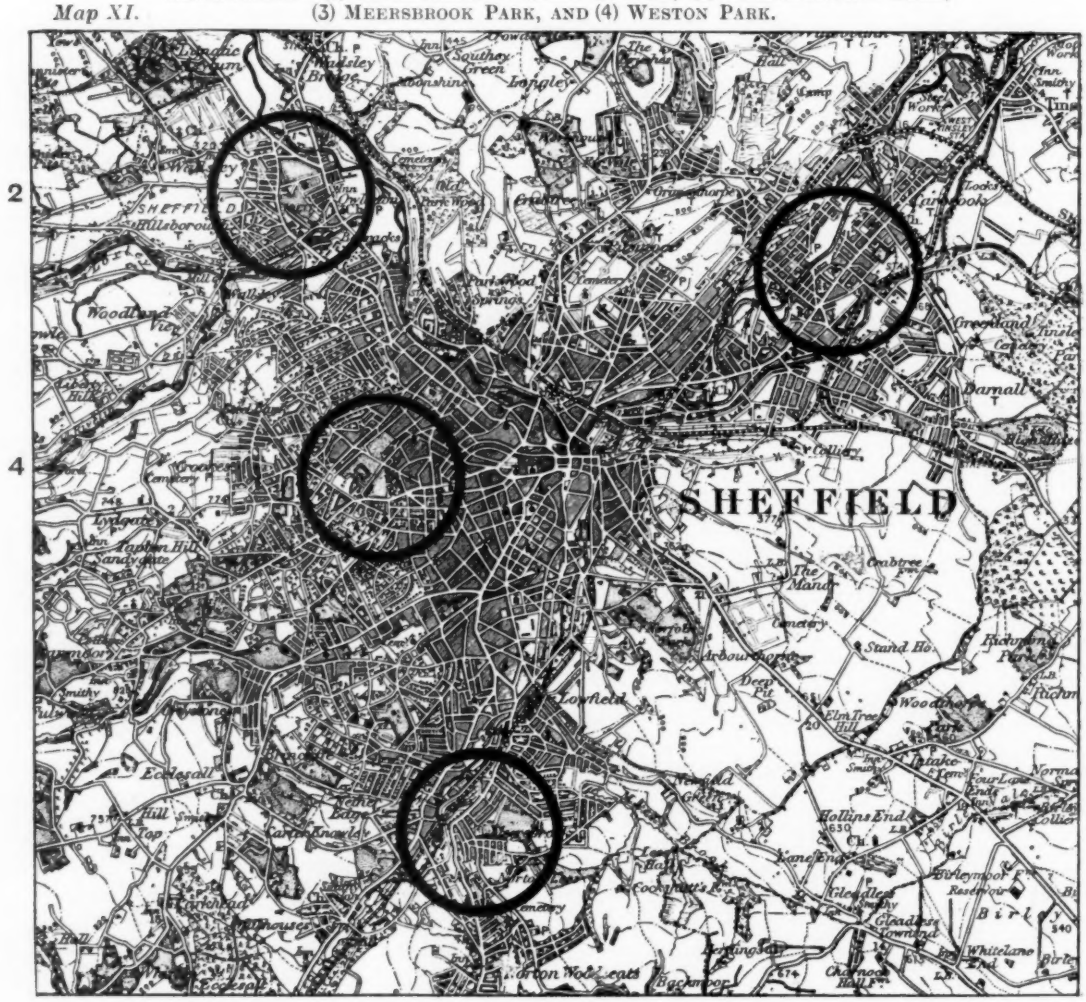
NEWCASTLE-UPON-TYNE (MAP IX., p. xx.).

1914.										
April	15·31	0·17	4·05	10·55	0·98	2·17	17·92	1·27	0·24	0·04
May	29·19	0·12	3·18	5·56	0·93	1·93	11·72	1·37	0·25	0·04
June	96·01	0·20	3·83	6·55	2·30	3·07	15·95	1·70	0·47	0·19
July	69·0	0·14	3·42	5·19	0·96	2·75	12·46	1·84	0·31	0·20
August	32·0	0·12	3·87	6·52	0·78	2·14	13·44	1·30	0·22	0·08
September	47·0	0·07	2·97	5·03	0·76	1·51	10·33	1·30	0·22	0·07
October	42	0·18	3·74	5·78	1·91	4·15	16·47	2·34	0·60	0·13
November	82	0·19	4·22	6·81	2·46	5·08	18·77	3·00	0·67	0·21
December	88	0·12	4·71	8·35	1·75	7·53	22·46	3·12	1·38	0·42
1915.										
January	50	0·12	3·65	5·36	2·97	3·77	15·87	2·85	0·32	0·13
February	65	0·09	3·25	5·72	2·47	5·06	16·59	2·86	0·64	0·18
March	52	0·10	3·38	5·50	1·66	3·94	14·59	2·50	0·48	0·15
Total	667·51	1·62	44·27	76·92	19·93	43·10	186·57	25·45	5·80	1·84
Monthly mean	56	0·13	3·69	6·41	1·66	3·59	15·55	2·12	0·48	0·15

Map X. OLDHAM.



Map XI. SHEFFIELD—(1) ATTERCLIFFE BURIAL GROUND, (2) HILLSBOROUGH PARK, (3) MEERSBROOK PARK, AND (4) WESTON PARK.



OLDHAM (MAP X., p. xxii.).

	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
1914.										
August	92·0	0·16	3·25	8·26	1·84	5·53	19·04	1·48	0·59	0·16
September	42·0	0·27	5·06	12·90	1·56	3·12	22·10	1·21	0·68	0·10
October	62	0·62	6·65	15·80	1·49	4·47	29·00	2·54	0·44	0·29
November	112	0·26	6·55	14·60	2·68	7·60	31·70	4·36	0·79	1·84
December	120	0·27	7·61	17·40	2·88	8·66	36·80	3·99	1·41	0·17
1915.										
January	119	0·27	5·68	11·69	4·78	11·46	33·80	5·11	0·93	0·14
February	105	0·44	9·57	17·40	3·78	9·68	40·90	4·21	1·34	0·16
March	46	0·38	6·49	20·4	2·41	6·30	36·0	2·59	0·89	0·13
Total	698·0	2·67	50·86	118·45	21·42	56·82	249·34	25·49	7·07	2·99
Monthly mean	87	0·33	6·36	14·81	2·68	7·10	31·17	3·19	0·88	0·37

SHEFFIELD, ATTERCLIFFE (MAP XI., p. xxii.).

1914.										
July	62·0	0·36	3·49	11·86	1·79	6·53	24·03	3·17	1·28	0·06
August	32·0	0·48	3·45	10·62	1·36	5·43	21·34	2·68	1·08	0·05
September	30·0	0·69	3·16	10·21	1·42	5·51	20·99	2·50	1·12	0·07
October	51	0·27	4·78	8·73	1·58	6·85	22·21	3·08	1·76	0·16
November	72	0·12	4·01	9·36	1·80	7·61	22·90	3·59	1·74	0·05
December	100	0·13	4·02	8·77	2·31	7·25	22·48	3·44	1·82	0·07
1915.										
January	62	0·13	3·78	8·46	1·49	6·17	20·03	2·45	1·79	0·15
February	77	0·19	3·20	7·07	2·30	6·26	19·02	2·66	1·94	0·10
March	32	0·14	3·84	8·36	2·05	4·43	18·82	1·91	1·61	0·03
Total	518·0	2·51	33·73	83·44	16·10	56·04	191·82	25·48	14·14	0·74
Monthly mean	58	0·28	3·75	9·27	1·79	6·23	21·31	2·83	1·57	0·08

SHEFFIELD, HILLSBOROUGH PARK (MAP XI., p. xxii.).

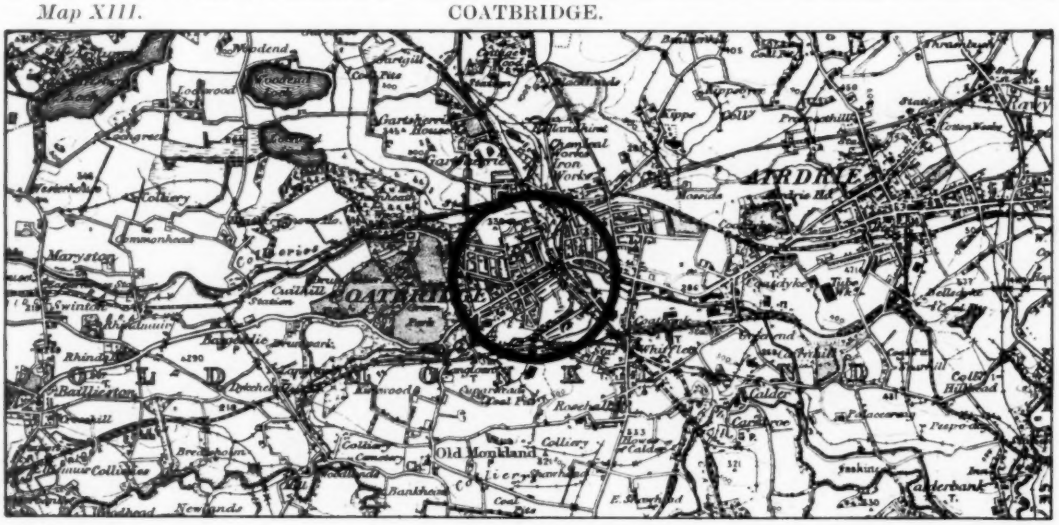
1914.										
July	54·0	0·47	0·29	2·20	0·52	3·44	6·92	1·18	1·00	0·05
August	32·0	0·36	0·74	3·01	0·89	2·36	7·36	1·18	0·58	0·03
September	39·0	0·10	0·26	2·71	0·76	2·62	6·45	1·43	0·81	0·07
October	49	0·06	1·49	4·04	1·26	3·79	10·64	2·22	0·76	0·04
November	91	0·06	1·44	4·86	1·17	4·90	12·43	2·66	1·08	0·03
December	108	0·09	1·42	3·32	0·50	6·35	11·68	2·51	1·28	0·07
1915.										
January	71	0·08	1·27	4·54	1·25	4·94	12·08	2·04	0·64	0·04
February	75	0·11	1·48	4·43	1·50	4·21	11·73	1·90	0·70	0·04
March	35	0·08	1·47	4·09	0·95	4·13	10·72	2·28	0·67	0·03
Total	554·0	1·41	9·86	33·20	8·80	36·74	90·01	17·40	7·52	0·40
Monthly mean	62	0·16	1·09	3·69	0·98	4·08	10·00	1·93	0·84	0·04

SHEFFIELD, MEERSBROOK PARK (MAP XI., p. xxii.).

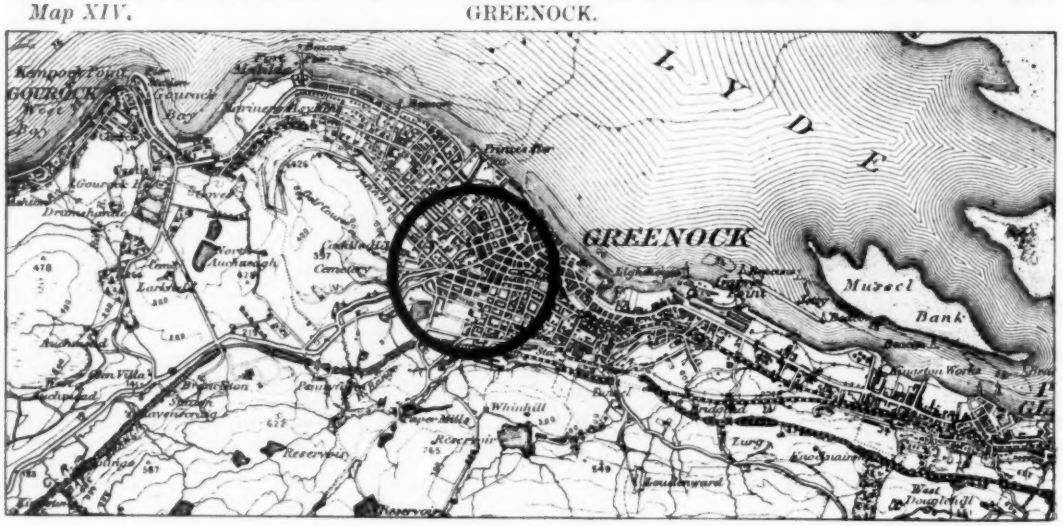
1914.										
July	66·0	0·06	1·40	2·06	1·27	2·55	7·36	1·44	0·78	0·06
August	50·0	0·48	0·45	1·80	0·64	2·05	5·42	0·98	0·67	0·04
September	31·0	0·42	0·45	2·60	0·87	3·03	7·37	1·35	0·56	0·04
October	56	0·13	1·43	3·38	0·72	4·74	10·40	1·97	0·86	0·04
November	78	0·05	1·18	3·13	0·75	5·48	10·59	2·32	1·00	0·04
December	124	0·10	0·91	2·17	2·67	4·16	10·01	2·81	1·50	0·06
1915.										
January	76	0·08	1·56	4·03	1·52	4·70	11·89	2·20	0·85	0·05
February	85	0·08	1·34	3·38	1·50	4·08	10·38	2·53	0·80	0·05
March	33	0·08	1·88	5·22	0·88	5·00	13·06	2·13	0·66	0·03
Total	599·0	1·48	10·60	27·77	10·82	35·79	86·48	17·73	7·68	0·41
Monthly mean	67	0·16	1·18	3·08	1·20	3·98	9·61	1·97	0·85	0·04

Map XII. YORK.

Map XIII. COATBRIDGE.



Map XIV. GREENOCK.



SHEFFIELD, WESTON PARK (MAP XI., p. xxii.).

	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
1914.										
July	56·0	0·48	0·95	3·72	0·90	3·57	9·63	1·37	0·95	0·08
August	36·0	0·55	0·34	2·92	1·50	2·94	8·25	1·20	0·47	0·03
September	41·0	0·40	0·89	4·15	1·22	2·64	9·30	1·55	0·60	0·06
October	50	0·11	1·53	3·03	1·45	4·30	10 42	2·58	0·74	0·04
November	87	0·11	2·04	5·77	1·60	4·51	14·03	2·39	0·97	0·03
December	111	0·12	1·36	3·20	1·77	5·68	12·13	2·56	1·21	0·04
1915.										
January	83	0·08	1·38	3·79	1·53	5·65	12·43	2·72	0·93	0·04
February	72	0·09	0·94	2·11	1·61	3·16	7·91	2·13	0·64	0·05
March	36	0·05	1·45	4·42	2·03	4·43	12·38	2·77	0·65	0·03
Total	572·0	1·99	10·88	33·11	13·61	36·88	96·48	19·27	7·16	0·40
Monthly mean	64	0·22	1·21	3·68	1·51	4·10	10·72	2·14	0·79	0·04

YORK (MAP XII., p. xxiv.).

1914.										
April	13·23	0·11	2·17	3·26	0·96	1·69	8·19	0·78	0·34	0·52
May	33·73	0·02	0·85	3·15	1·08	1·35	6·45	0·91	0·38	0·10
June	51·00	0·10	1·47	3·51	1·01	2·83	8·92	1·19	0·47	0·19
July	116·0	0·08	1·30	1·61	1·39	3·24	7·61	1·27	0·50	0·54
August	39·0	0·11	1·89	3·67	0·78	2·32	8·79	1·04	0·27	0·25
September	27·0	0·05	1·69	3·22	0·76	1·31	7·02	0·86	0·33	0·18
October	41	0·08	1·43	3·08	1·49	1·83	7·91	1·48	0·46	0·28
November	70	0·13	1·92	3·03	1·68	3·64	10·41	2·10	0·67	0·50
December	106	0·14	1·92	3·34	1·70	5·11	12·21	2·85	1·21	0·80
1915.										
January	65	0·11	1·49	3·14	2·34	3·63	10·71	1·71	0·64	0·50
February	62	0·10	1·50	3·53	1·25	3·49	9·86	2·37	0·71	0·55
March	28	0·08	1·08	4·63	1·09	2·8	10·41	1·49	0·44	0·07
Total	651·96	1·11	18·71	39·17	15·53	33·24	108·49	18·05	6·42	4·48
Monthly mean	54	0·09	1·56	3·26	1·29	2·77	9·04	1·50	0·53	0·37

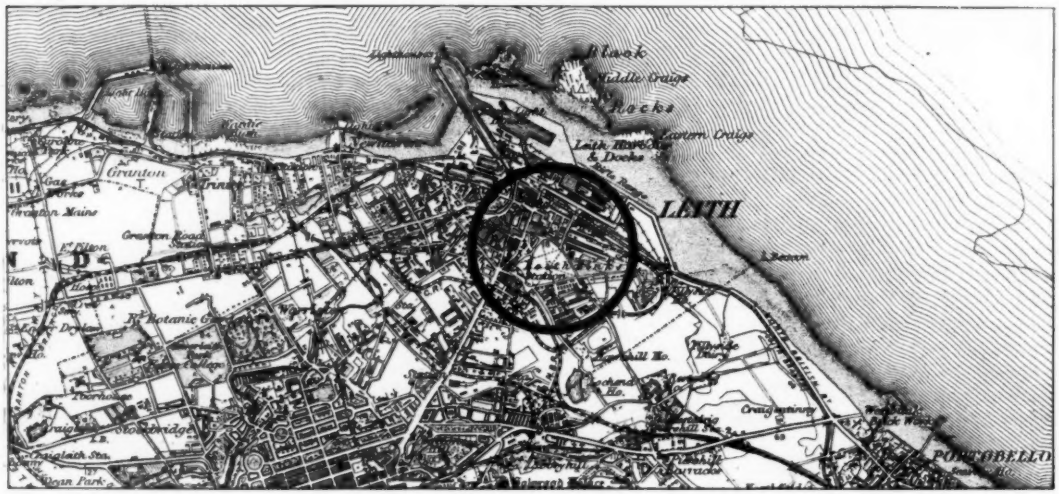
COATBRIDGE (MAP XIII., p. xxiv.).

1914.										
October	41	0·05	1·12	2·30	0·56	1·73	5·76	0·90	0·21	0·05
November	107	0·14	2·33	5·54	1·15	2·14	11·30	1·39	0·33	0·10
1915.										
March	62	0·08	1·21	2·36	1·03	1·94	6·62	1·13	0·27	0·10
Total	210	0·27	4·66	10·20	2·74	5·81	23·68	3·42	0·81	0·25
Monthly mean	70	0·09	1·55	3·40	0·91	1·94	7·89	1·14	0·27	0·08

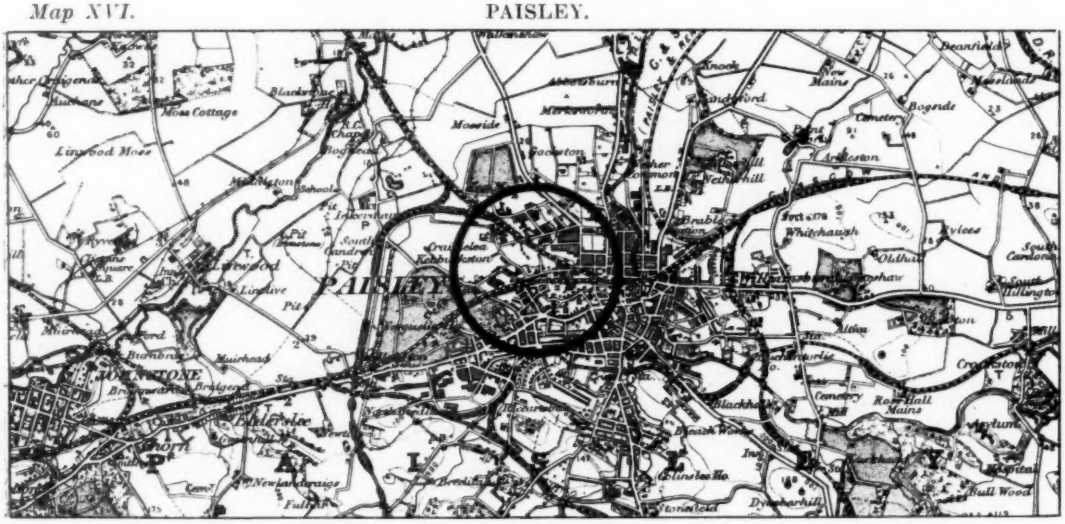
GREENOCK (MAP XIV., p. xxiv.).

1914.										
April	94·70	0·03	1·32	3·13	1·71	3·45	9·64	1·37	0·81	0·07
May	52·30	0·04	1·93	4·51	1·39	2·25	10·12	1·01	0·22	0·08
June	25·00	0·05	2·06	3·88	0·74	1·17	7·90	0·71	0·13	0·03
July	41·0	0·05	2·01	4·00	1·89	2·00	9·94	1·49	0·14	0·09
August	120·0	0·03	1·64	2·69	1·80	2·39	8·54	1·03	0·21	0·06
September	58·0	0·06	1·50	3·61	0·69	1·50	7·37	0·74	0·29	0·05
November	118	0·09	1·58	2·37	1·50	3·81	9·36	1·69	0·89	0·14
December	193	0·09	2·39	4·79	2·92	7·04	17·22	3·54	1·81	0·26
1915.										
January	87	(Bottle burst by frost.)			1·32	2·74	0·00	1·53	0·67	0·11
February	209	0·12	3·53	6·38	3·23	5·58	18·86	3·31	0·90	0·24
March	77	0·06	3·84	6·78	1·93	2·79	15·41	2·25	0·29	0·16
Total	1075·00	0·62	21·80	42·14	19·12	34·72	114·36	18·67	6·36	1·29
Monthly mean	98	0·06	1·98	3·83	1·74	3·16	10·40	1·70	0·58	0·12

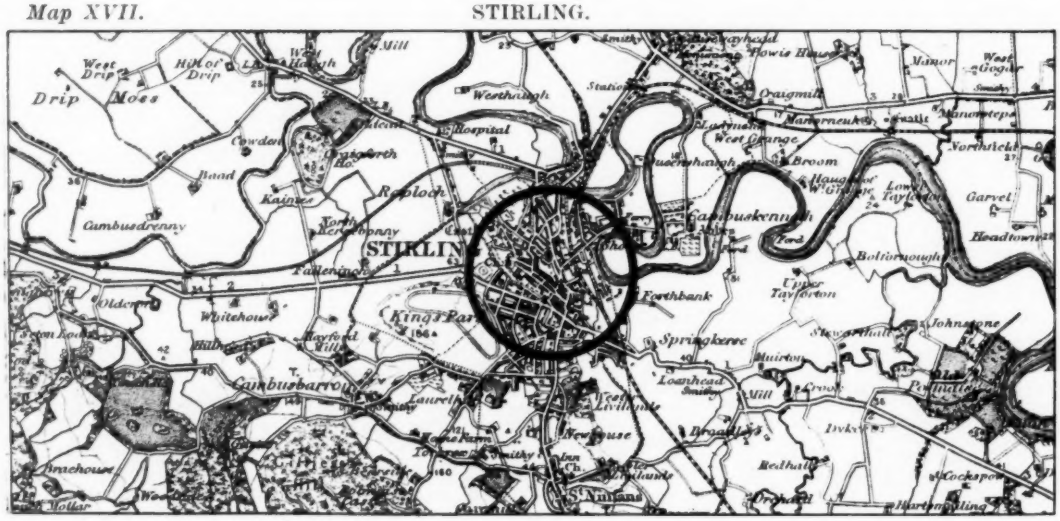
Map XV. LEITH.



Map XVI. PAISLEY.



Map XVII. STIRLING.



LEITH (MAP XV., p. xxvi.).

	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
1914.										
April	24·63	0·08	1·01	3·27	1·53	1·02	6·91	0·79	0·21	0·05
May	46·10	0·05	0·79	2·09	1·19	1·19	5·32	0·98	0·18	0·09
June	18·00	0·05	1·24	2·32	1·41	0·47	5·50	0·54	0·33	0·09
July	60·00	0·07	1·44	2·63	0·94	2·20	7·28	1·13	0·15	0·12
August	43·0	0·10	1·76	4·27	0·44	2·21	8·78	1·03	0·10	0·06
September	13·0	0·03	0·91	1·79	0·20	0·80	3·74	0·49	0·09	0·03
October	44	0·08	2·40	4·72	1·14	3·86	12·20	1·80	0·53	0·09
November	55	0·07	1·88	4·47	2·83	1·41	10·66	1·65	0·48	0·32
1915.										
January	23	0·03	0·80	2·88	1·20	1·82	6·73	0·97	0·20	0·18
February	36	0·07	0·92	3·07	2·02	2·75	8·83	1·34	0·32	0·11
March	33	0·06	0·76	3·17	1·47	3·34	8·80	1·38	0·88	0·13
Total	395·73	0·69	13·91	34·68	14·37	21·07	84·75	12·10	3·47	1·27
Monthly mean	36	0·06	1·26	3·15	1·30	1·91	7·70	1·10	0·31	0·11

PAISLEY (MAP XVI., p. xxvi.).

1914.										
April	75·80	0·08	4·17	6·46	2·42	2·73	15·87	1·67	0·76	0·09
May	49·68	0·15	4·53	6·66	1·20	1·99	14·55	0·89	0·35	0·02
June	13·82	0·10	3·66	7·06	0·44	1·22	12·48	0·61	0·10	0·26
July	59·0	0·09	2·65	4·26	2·13	1·66	10·79	1·02	0·28	0·06
August	107·0	0·11	2·57	4·15	2·57	3·42	12·82	1·32	0·38	0·09
September	43·0	0·12	3·62	4·04	2·23	1·55	11·56	0·99	0·40	0·05
October	36	0·14	2·89	3·21	2·01	2·15	10·40	1·40	0·25	0·08
November	137	0·33	4·97	7·10	6·05	5·50	23·95	2·03	1·23	0·14
December	194	0·33	3·80	4·83	6·20	9·29	24·45	3·18	3·29	0·21
1915.										
January	67	0·16	4·92	5·82	2·66	3·20	16·76	1·72	0·49	0·06
February	140	0·28	3·02	4·65	4·46	4·47	16·88	2·64	0·47	0·10
March	46	0·20	4·44	7·84	1·84	3·32	17·64	1·33	0·18	0·05
Total	968·30	2·09	45·24	66·08	34·21	40·50	188·15	18·80	8·18	1·21
Monthly mean	81·0	0·17	3·77	5·50	2·85	3·37	15·68	1·57	0·68	0·10

STIRLING (MAP XVII., p. xxvi.).

1914.										
December	171	0·14	3·51	1·41	4·11	3·56	12·74	1·85	1·77	0·10
1915.										
January	42	0·23	2·04	2·36	1·84	2·54	9·01	1·73	0·45	0·08
February	147	0·45	1·41	3·44	1·97	3·98	11·25	2·96	0·10	0·20
Total	360	0·82	6·96	7·21	7·92	10·08	33·00	6·54	2·32	0·38
Monthly mean	120	0·27	2·32	2·40	2·64	3·36	11·00	2·18	0·77	0·13

DISCUSSION OF THE RESULTS OF THE YEAR'S OBSERVATIONS.

(*See Tables and Maps, pp. viii. to xxvii.*)

I.—COMPARISON OF STATIONS ON THE BASIS OF THE MEAN VALUES OF THE SIX MONTHS, OCTOBER, 1914, TO MARCH, 1915.

It must be understood from the beginning that with the brief experience which has already been gained it is not possible to use the methods of checking and criticising the various figures of the returns which are customary in dealing with meteorological returns. With so intricate and elaborate an investigation it is too much to hope that the final figures are entirely devoid of errors. In this first discussion of the results the figures have been accepted, and some of the peculiarities noticed may have no more basis than some oversight on the part of the analyst or computer. The comparison of the rainfall measurements with the meteorological returns shows some peculiarities which are not accounted for. (See Appendix I.)

The analysis of Atmospheric Pollution has necessarily been guided by the facilities of chemical analysis to separate the different constituents of atmospheric impurity. The elements evolved are:—

(1) Tar and other carbon compounds soluble in carbon bisulphide.

(2) Carbonaceous matter which is not soluble in that reagent.

(3) Ash which is included in the residue after the first filtration.

(4) Loss on ignition—i.e., the volatile and combustible parts of the compounds dissolved in the rain water.

(5) The residual ash from these compounds—after the ignition.

These five together make up the total solids collected in the gauge (6). A separate estimate is given of the amount of sulphates as SO_4 (7), of chlorides as Cl (8), and of ammonia as NH_3 (9).

With reference to these elements we may note: (1) The tar in the atmosphere is produced by the imperfect combustion of coal or wood and, recently, by the introduction of the practice of tarring roads; (2) the carbonaceous matter other than tar may consist of coal-dust or of unconsumed carbon carried into the atmosphere by draughts through fires, also any fragments of animal or vegetable matter, animal refuse, pollen, and blown seeds; (3) the insoluble ash includes the dust of mineral origin carried from roads or open country by the wind; and (4) and (5) deal with the acids and salts dissolved in the rain water which are included in the products of combustion of coal. The loss on ignition is due to the soluble organic matter, ammonia salts, the carbonates of the alkaline earths. The sulphuric acid referred to is included in the soluble portion. The chlorine may get into the atmosphere in the form of chloride of sodium from the spray of sea water. Ammonia is produced with tar by destructive distillation in the combustion of coal and by the decay of animal refuse.

For 25 out of the whole number of 39 stations the results for the six months October, 1914, to March, 1915, are available, and for these monthly means have been taken of the various elements which are specified in the table of results. Monthly means for other stations have been included in the table, although the whole number of months from October to March is not complete; the number upon which the mean depends is indicated.

In order to enable the reader to make an effective comparison of the different stations at a glance, the numerical results for each element have been arranged in four groups or classes. The principle of classification has been to draw dividing lines based upon the following law:—

Class A includes the stations which have less than 1 unit of deposit per square kilometre.

Class B, the stations which have between 1 and 3 units of deposit per square kilometre.

Class C, the stations which have between 3 and 5 units of deposit per square kilometre.

Class D, the stations which have 5 or more units of deposit per square kilometre.

The unit has been adjusted to suit each separate element, but the proportional division has been kept the same throughout. Thus for "total solids" the unit is 5 tons and the law of classification is—

Class A, less than 5 tons per square kilometre per month.

Class B, from 5 to 15 tons per square kilometre per month.

Class C, from 15 to 25 tons per square kilometre per month.

Class D, from 25 or more tons per square kilometre per month.

It will be understood that the figure 5 belongs to Class B, not Class A, and so on.

The units and limits in the several cases are as follows:—

Insoluble Matter.

	Unit.	Limits.			
	—	Tons per K^2 per month	A Less than	B	C	D Over
Tar		0·05	0·05	0·05 to 0·15	0·15 to 0·25	0·25
Carbonaceous other than tar		1	1	1 to 3	3 to 5	5
Ash		2	2	2 to 6	6 to 10	10

Soluble Matter.

Loss on ignition	0·75	0·75	0·75 to 2·25	2·25 to 3·75	3·75
Ash	1·5	1·5	1·5 to 4·5	4·5 to 7·5	7·5
Total solids	5	5	5 to 15	15 to 25	25
Sulphates ...	1	1	1 to 3	3 to 5	5
Chlorine ...	0·3	0·3	0·3 to 0·9	0·9 to 1·5	1·5
Ammonia ...	0·05	0·05	0·05 to 0·15	0·15 to 0·25	0·25

The limits have been selected with the view of including a few stations in Class A and a few in Class D, leaving the majority of the stations to be included in one or other of the intermediate Classes B and C. The selection might be improved by reducing the unit of "Carbon other than tar" to 0·75, because the constituent units would then add up almost exactly to the unit for total solids, but with the limited experience available the change is not worth the labour involved in it, and, moreover, the middle values between the B and C classes agree very well with the means of the recorded values.

The results are shown in the table following.

Monthly Means of the Several Elements of Pollution.

Station.	Number of months.	Rainfall, mean mm.	Insoluble. Units in tons per square kilometre per month.			Soluble. Units in tons per square kilometre per month.						Summary.
			Tar.	Carbonaceous matter other than tar.	Ash.	Loss on ignition.	Ash.	Total solids.	Sulphuric acid.	Chlorine.	Ammonia.	
			0·05	1	2	0·75	1·5	5	1	0·3	0·05	A B C D
Birmingham Central	6	77	C	C	D†	B	C	C	C	B	B	0 3 5 1
,, Aston	6	73	B	B	B	B	B	B	B	B	A	1 8 0 0
,, S.W.	6	84	A	A	A	A*	B	B	B	B	A†	5 4 0 0
Bolton	6	121	B	B	C	D*	D*	C	D*	D*	B	0 3 2 4
Exeter	6	88	A	B	B	B	B	B	B	B	A	2 7 0 0
Kingston-upon-Hull	6	64	B	B	B	C	C	B	B	B	B	0 7 2 0
Liverpool	6	75	D†	B	C	C	C	C	C	C	D*	0 1 6 2
London—												
Meteorological Office	6	64	B	A	B	D†	C	B	B	C	B	1 5 2 1
Embankment Gardens	6	66	C	C	C	B	C	C	C	C	B	0 2 7 0
Finsbury Park	6	65	C	B	B	B	C	B	B	B	B	0 7 2 0
Ravenscourt Park	6	64	B	B	B	B	B	B	B	B	B	0 9 0 0
Southwark Park	6	75	B	C	C	B	C	C	C	B	B	0 4 5 0
Wandsworth Common	6	56	A	A	B	B	C	B	B	B	A	3 5 1 0
Victoria Park	6	66	B	B	B	B	C	B	C	B	B	0 7 2 0
Golden Lane	6	73	B	C	B	C	C	C	C	B	B	0 4 5 0
Malvern	6	53	A*	A*	A*	A*	A*	A*	A*	A†	A*	9 0 0 0
Manchester—												
Ancoats Hospital	3	78	B	C	D	B	D†	D†	D†	C	B	0 3 2 4
Bowdon	3	69	A†	A†	A†	A	B	B	B	B	B	4 5 0 0
Cheadle	5	66	B	B	B	B	B	B	B	B	B	0 9 0 0
Davyhulme	5	70	A	B	B	B	C	B	B	B	B	1 7 1 0
Fallowfield	5	70	B	B	B	B	C	B	B	B	B	0 8 1 0
Moss-side	3	75	B	B	B	B	C	C	C	C	B	0 5 4 0
Philips Park	3	71	B	C	C	B	C	C	C	C	B	0 3 6 0
Queen's Park	3	74	B	B	C	B	C	C	C	C	A	1 3 5 0
School of Technology	6	77	B	C	C	B	C	C	C	C	B	0 3 6 0
University	1	86	B	C	C	B	C	C	C	C	B	0 3 6 0
Whitefield	5	87	A	B	B	B	C	B	C	C	D	1 4 3 1
Newcastle-upon-Tyne	6	63	B	C	C	B	C	C	B	B	C	0 4 5 0
Oldham	6	94	D*	D*	D*	C	D	D*	C	C	D†	0 0 3 6
Sheffield Attercliffe	6	66	C	C	C	B	C	C	B	D†	B	0 3 5 1
,, Hillsborough Park	6	71	B	B	B	B	C	B	B	B	A	1 7 1 0
,, Meersbrook Park	6	75	B	B	B	B	C	B	B	C	B	0 7 2 0
,, Weston Park	6	73	B	B	B	B	C	B	B	B	A	1 7 1 0
York	6	62	B	B	B	B	B	B	B	B	D†	0 8 0 1
Coatbridge	3	70	B	B	B	B	B	B	B	A*	B	1 8 0 0
Greenock	5	137	B	B	B	B	B	B	B	C	C	0 7 2 0
Leith	5	38	B	B	B	B	B	B	B	B	C	0 8 1 0
Paisley	6	103	C	C	B	D	C	C	B	C	B	0 3 5 1
Stirling	3	120	D	B	B	C	B	B	B	B	B	0 7 1 1

* Indicates the letters representing the highest and lowest records for each element in the list of stations.
† Indicates the second (if there is one) in Class A or Class D.

The thirty-nine stations group themselves in the several classes as follows :—

		A	B	C	D
Insoluble	Tar	7	24	5	3
	Carbonaceous matter other than tar	5	22	11	1
	Ash	3	23	10	3
Soluble	Loss on ignition	3	28	5	3
	Ash	1	11	24	3
	Total solids	1	22	14	2
	Sulphuric acid (SO_4)	1	23	13	2
	Chlorine (Cl)	2	21	14	2
	Ammonia (NH_3)	8	24	3	4

REMARKS ON THE TABLE.

(*The "Tons" in these Tables are Metric Tons of 2205 lbs.*)

The table enables us to make a comparison between different localities. Note, for example, in passing that in Manchester the School of Technology with six months' record gives the same results as the University, not far away, with only one. Davyhulme and Fallowfield are similar, except that Davyhulme gets the better mark for tar. Fallowfield and Moss-side are similar, except that there are more of the soluble constituents and acids at Moss-side. Similarly, Bowdon makes a very exemplary record, but gives way to Malvern, particularly in the matter of acids. Birmingham Central is almost identical with Sheffield (Attercliffe), but Birmingham has more sulphuric acid in its air and Sheffield much more chlorine. Birmingham (Aston), Ravenscourt Park, Cheadle, Leith, and York run entirely together with a succession of B's until the ammonia column is reached, when Birmingham (Aston) takes an A, Ravenscourt Park and Cheadle a B, Leith a C, and York a D. Exeter and Fallowfield would go with them, but the first gets an A for tar as well as for ammonia. Coatbridge would also present a uniform set of B's but for the striking absence of chlorine. The comparatively large figures for soluble ash indicated by the C's of the London, Manchester, and Sheffield stations, with Bolton, Newcastle, and Oldham, are striking as compared with the B's for Birmingham and Scottish stations. Malvern is obviously conspicuous by its row of A's, Bolton, Ancoats, and Oldham by their D's.

Tar, Other Carbonaceous Matter, and Insoluble Ash.

	Highest.	Tons per K² per month.	Lowest.	Tons per K² per month.
Tar	Oldham	0·37	Malvern	0·00
	Liverpool	0·29	Manchester, Bowdon	0·01
	Stirling	0·27	Manchester, Davyhulme	0·02
Other carbonaceous matter	Oldham	7·09	Malvern	0·13
			Manchester, Bowdon	0·49
			Birmingham S.W.	0·77
Insoluble ash	Oldham	16·21	Malvern	0·25
			Manchester, Bowdon	1·78
			Birmingham S.W.	1·99

Tar and other carbonaceous matter do not follow one another very closely. Exeter gets an A for tar and a B for other carbonaceous matter, so do Ravenscourt Park, Victoria Park, Davyhulme, Whitefield; and other carbonaceous matter is relatively worse than tar at Golden Lane (London), Ancoats, Philips Park, School of Technology, University (Manchester), and Newcastle-upon-Tyne. On the other hand, the Meteorological Office gets a B for tar and an A for other carbonaceous matter, and Liverpool a D for tar and only a B for other carbonaceous matter, and so does Stirling. The insoluble ash is relatively prominent at Liverpool, the Meteorological Office, and Wandsworth Common, but relatively inconspicuous at Embankment Gardens, Southwark Park, Golden Lane, in Central Manchester (School of Technology and University), Newcastle-upon-Tyne, Paisley, and Stirling. This deposit includes wind-carried dust and is therefore a good deal dependent upon the exposure of the gauge.

Soluble Constituents, Loss on Ignition and Ash.

	Highest.	Tons per K² per month.	Lowest.	Tons per K² per month.
Loss on ignition	Bolton	4·49	Birmingham S.W. Malvern	0·63
	London Meteorological Office	3·91	Manchester, Bowdon	0·66
	Paisley	3·87		
Ash	Bolton	9·64	Malvern	1·03
	Ancoats	8·69		
	Oldham	8·03		

The loss on ignition is relatively conspicuous at the Meteorological Office, Paisley and Stirling, the ash in the urban districts, where, as a rule, it is indicated by C's as compared with B's for the loss on ignition; this is especially noteworthy at Ancoats. Both are relatively abundant at Kingston-upon-Hull, and conspicuously so at Bolton.

Total Solids.

Highest.	Tons per K² per month.	Lowest.	Tons per K² per month.
Oldham	34·70	Malvern	2·05
Manchester, Ancoats	26·79		

The lowest figure next to Malvern is Bowdon with 5·69 tons and the next Birmingham S.W. with 6·04 tons, both of which are in Class B. Twenty-two stations get between 5 and 15 tons per square kilometre per month and 14 between 15 and 25 tons. The most interesting point about these figures is the differences shown by the stations in the same district, thus:—

Of 3 Birmingham stations ... 2 get B and 1 C.
„ 8 London stations ... 5 get B and 3 C.
„ 13 Stations including Manchester, Bolton, and Oldham ... 5 get B, 6 C, and 2 D.
„ 4 Sheffield stations ... 3 get B and 1 C.
1 Scottish station gets C, the rest B.

Sulphuric Acid, Chlorine, and Ammonia.

	Highest.	Tons per K² per month.	Lowest.	Tons per K² per month.
Sulphuric acid as (SO_4)	Bolton	5·54	Malvern	0·53
	Manchester, Ancoats	5·03	Coatbridge	1·14
			Birmingham Aston	1·16
Chlorine (Cl)	Bolton	2·02	Coatbridge	0·27
	Sheffield Attercliffe	1·78	Malvern	0·29
Ammonia (NH_3)	Liverpool	0·57	Malvern	0·01
	York Oldham	0·45	Birmingham S.W.	0·02
			Exeter	0·03

Sulphuric acid is generally in the same proportion as the total solids; the agreement is quite striking. The exceptions are Bolton, London (Victoria Park), Manchester (Whitefield), comparatively richer in acid, Newcastle-upon-Tyne, Oldham

Deposit per Acre per Month.

—	Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.	Total solids.	SO_3	Cl	NH_3
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
CLASS A (The Malvern type) ...	0·23	4·5	9	5·4	6·8	23	4·5	1·4	0·23
CLASS B (The Ravenscourt Park or Cheadle type) ...	0·9	18	36	13·5	27	90	18	5·4	0·9
CLASS C (The Liverpool or Embankment Gardens type)	1·8	36	72	27	54	180	36	10·8	1·8
CLASS D (The Oldham type) ...	Over 2·25	Over 45	Over 90	Over 34	Over 68	Over 225	Over 45	Over 14	Over 2·3

Sheffield (Attercliffe), and Paisley comparatively poorer, but there is only the difference of one class in any case. Chlorine is rather more irregular; the classification agrees with that for sulphuric acid in 28 cases. The chlorine is relatively conspicuous by its presence at the Meteorological Office, Sheffield (Attercliffe and Meersbrook Park), Greenock, and Paisley, specially so at Sheffield (Attercliffe), and relatively in defect at Birmingham Central, London (Southwark Park, Victoria Park, and Golden Lane), Manchester (Ancoats), and Coatbridge.

Ammonia.—The results for ammonia are very similar to those for tar. The great majority of the stations, 24 out of 39, get B's, Greenock, Leith, and Newcastle-upon-Tyne get C's, and, with a considerable interval, Liverpool, York, Oldham, and Manchester (Whitefield) get D's. The Liverpool result is much influenced by a very large figure for a single month.

THE ORDINARY AIR WE BREATHE.

So far as this group of stations is concerned we may regard the dividing line between Class B and Class C as representing the average atmosphere of the winter months; and it is therefore interesting to state that the average atmosphere may be expected to deposit upon a square kilometre in any one winter month 15 tons of solid matter, which may be regarded as made up of 0·15 ton of tarry matter, 3 tons of carbonaceous matter other than tar, 6 tons of insoluble inorganic dust, besides soluble salts, which include 3 tons of sulphuric acid, a ton of chlorine, and 0·3 ton of ammonia. Taking 250 acres to the square kilometre, 1 ton per square kilometre works out at rather less than a hundredweight to 12½ acres, or 9 lb. per acre. Hence, on the average, the atmospheres of the several classes represent deposit per acre in a month as shown in the table of deposit per acre given above.

In the preceding discussion we have dealt with all the nine elements into which the pollution has been analysed, as though each one of them was independent of the rest. This is, of course, not really the case, because the figures for total solids represent the aggregate of the figures for the five elements which are enumerated first, and the sulphuric acid, chlorine, and ammonia are also included in the total solids. If we confine our attention to the first five elements we may avoid the cumulative effect upon the general result. We can thus summarise the results for the winter by giving the number of A's, B's, C's, and D's for each station in the five columns of the table appropriated to tar, carbon, insoluble ash, loss on ignition, and ash in the soluble portion; the results work out as follows:—

A	B	C	D	
5	0	0	0	Malvern
4	1	0	0	Birmingham, S.W.
	,,			Manchester, Bowdon
2	2	1	0	London, Wandsworth Common
1	4	0	0	Exeter
1	3	1	0	Manchester, Davyhulme
	,,			,, Whitefield
1	2	1	1	London, Meteorological Office
0	5	0	0	Birmingham, Aston
	,,			London, Ravenscourt Park
	,,			Manchester, Cheadle
	,,			York
	,,			Coatbridge
	,,			Greenock
	,,			Leith
0	4	1	0	London, Victoria Park
	,,			Manchester, Fallowfield
	,,			,, Moss-side
	,,			Sheffield, Hillsborough Park
	,,			,, Meersbrook Park
	,,			,, Weston Park
0	3	2	0	Kingston-upon-Hull
	,,			London, Finsbury Park
	,,			Manchester, Queen's Park
0	1	4	0	London, Embankment Gardens
0	2	3	0	,, Southwark Park
	,,			,, City, Golden Lane
	,,			Manchester, Philips Park
	,,			,, School of Technology
	,,			,, University
	,,			Newcastle-upon-Tyne
0	2	1	2	Bolton
	,,			Manchester, Ancoats
0	3	1	1	Stirling
0	1	4	0	Sheffield, Attercliffe
0	1	3	1	Birmingham, Central
	,,			Liverpool
	,,			Paisley
0	0	1	4	Oldham

In considering these results regard should be had to the positions selected for the gauges and their surroundings. These are indicated on a strictly uniform scale in the series of maps on pp. ix.–xxvi., which have been taken from the one-inch Ordnance maps, and in which the positions of the several gauges are indicated by circles.

II. THE RELATION OF POLLUTION TO THE SEASONS OF THE YEAR AND TO WEATHER.

By the use of the method indicated above we can gain an insight into the relation between the various elements of atmospheric pollution and the season of the year. It may be expected beforehand that there should be a relation, because the production of pollution by domestic fires is one of the most noteworthy characteristics of the colder seasons; the question which is put here, therefore, is for which of the elements the variation is most conspicuous. Another point is suggested by the fact that the closing months of 1914 were extremely rainy, and the exaggerated rainfall of December is certainly associated, as a rule, with large amounts of pollution collected. This is in itself surprising, because with frequent rainfall the roads and roofs are kept well washed. The only explanation seems to be that the December pollution came down locally with the rain instead of being dispersed over a wider area; but this conclusion can only apply to those gauges which are near sources of pollution, such as Embankment Gardens, to take a special instance. With a properly distributed series of gauges for the country as a whole we ought to find an improvement of the atmosphere in country localities in consequence of the "washing" of the air in the neighbourhood of centres of production of pollution.

The question of the relation of the collection of pollution to wind is obviously an easy one to ask but not at all easy to answer. It is better to wait until the question can be formulated in a more tractable form.

In dealing with the seasonal variation attention will be directed exclusively to the results for those stations which have contributed figures for not less than eleven months—viz., Birmingham Central, Exeter, Kingston-upon-Hull, Liverpool, London (Meteorological Office, Embankment, and Golden Lane), Malvern, Newcastle-upon-Tyne, York, Leith, and Paisley.

Taking the limits A, B, C, D for the measures of a month's pollution, as they were defined in the examination of the mean monthly results of the winter half-year, we get a series of tables for each element in which the amount of pollution is indicated by a letter for each station and for each month. An * shows which of the monthly results for each station is the highest, and a † which is the lowest. The highest and the lowest record for the whole table is given at the foot of each table, with some notes of the most striking inferences.

Insoluble Matter: Tar.

—	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.
Birmingham Central	—	C	C	C	B†	B†	B	B	D*	C	C	B
Exeter	A	B	B*	B	A	A	A	A	B	A	A†	A
Kingston-upon-Hull	B	C*	B	B	B	B	B	B†	B	B	B	B
Liverpool	D	C	D	D*	B†	C	C	C	D	C	D	D
London—												
Meteorological Office	B	B	B	A†	A	B	B	B	C	C*	B	B
Embankment Gardens	D	D*	C	C	—	D†	B†	C	C	B†	D	C
Golden Lane	A	B	A	A	A	A†	B	B	B*	B	B	B
Malvern	*A*	A*	A	A	A	A	*A*	A	A	*A*	*A*	*A*
Newcastle-upon-Tyne	C	B	C*	B	B	B†	C	C	B	B	B	B
York	B	A†	B	B	B	B	B	B	B*	B	B	B
Leith	B	B	B	B	B*	A†	B	B	—	A†	B	B
Paisley	B†	C	B	B	B	B	B	D*	D*	C	D	C
Summary	A B C D 3 5 1 2	A B C D 2 5 4 1	A B C D 2 6 3 1	A B C D 3 6 2 1	A B C D 4 7 0 0	A B C D 4 6 1 1	A B C D 2 8 2 0	A B C D 2 6 3 1	A B C D 1 5 2 3	A B C D 3 5 4 0	A B C D 2 6 1 3	A B C D 2 7 2 1
Monthly rainfall in millimetres	23	40	43	70	45	35	38	76	118	71	79	27

Highest, 2·55, Liverpool, July.

Lowest, 0·00, Malvern, June to December.

The letters in italics are interpolated to complete the set.

The asterisks in the column for December and July, which were wet months, indicate that tar comes down with the rain, but the effect is not very conspicuous.

Insoluble Matter: Carbonaceous Matter other than Tar.

—	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.
Birmingham Central	—	C‖	C	C	B‡	B	C	C	D*	D	C	C
Exeter	B	B	B	B	B	B	B	B	B	B‡	B	B*
Kingston-upon-Hull	B	C	C	C*	C	B	C	B	B	B	B‡	B
Liverpool	B	C*	B	B	B‡	C	B	C	B	B	B	B
London—												
Meteorological Office	B*	B	B	A	B	B	A	B	B	B	A‡	A
Embankment Gardens	D	D*	C	C	—	D	C	B	B	C	C	B‡
Golden Lane	B	C	B	B	B‡	B	C	C*	C	B	C	C
Malvern	A	A	A	A*	A	A	A	A	A	A‡	A	A
Newcastle-upon-Tyne	C	C	C	C	C	B‡	C	C	C*	C	C	C
York	B*	A‡	B	B	B	B	B	B	B	B	B	B
Leith	B	A	B	B	B	A	B*	B	—	A	A	A‡
Paisley	C	C	C	B	B‡	C	B	C*	C	C	C	C

Summary	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
	1	7	2	1	3	2	6	1	1	6	5	0	2	6	4	0	1	8	2	0	2	7	2	1	2	5	5	0	1	6	5	0	1	6	3	1	2	6	3	1	3	4	5	0	3	5	4	0

Highest, 7·18, Embankment Gardens, May.

Lowest, 0·05, Malvern, January.

The results appear to be independent of rain.

Insoluble Matter: Ash.

—	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.
Birmingham Central	—	D*	D	D	C‡	C	D	D	D	D	C	D
Exeter	B*	B	B	B	B	B	B	B‡	B	B	B	B
Kingston-upon-Hull	B	B	B	B	B	B	B	B‡	B*	B	B	B
Liverpool	C	C	C	C	C	C	C	C	C	C	B‡	D*
London—												
Meteorological Office	B	B	B	B	B	A	A‡	B	B	C	B	C*
Embankment Gardens	C	C	C	B	—	C	B‡	B	C	C	D*	C
Golden Lane	B‡	B	B	B	B	B	B	B	B	B	B	C*
Malvern	A	A	A	A	A	A	A	A	A*	A‡	A	A
Newcastle-upon-Tyne	D*	B	C	B	C	B‡	B	C	C	B	B	B
York	B	B	B	B‡	B	B	B	B	B	B	B	B*
Leith	B	B	B	B	B	A‡	B	B*	—	B	B	B
Paisley	C	C	C	B	B	B	B‡	C	B	B	B	C*

Summary	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
	1	6	3	1	1	7	3	1	1	6	4	1	1	9	1	1	1	7	3	0	3	6	3	0	2	8	1	1	1	7	3	1	1	6	3	1	1	7	3	1	1	9	1	1	1	5	4	2

Highest, 15·92, Birmingham Central, May.

Lowest, 0·07, Malvern, January.

March gives the most, April, December, and June come next, July, October, and February are the most free from this form of impurity.

Soluble Matter: Loss on Ignition.

	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.
Birmingham Central	—	B	B	B	B‡	B	B	B	C	C*	B	B
Exeter	B	B	B	B	B	B	A	B	C*	B	C	A‡
Kingston-upon-Hull	B‡	C	B	B	B	B	D	B	B	C*	C	B
Liverpool	C	C	B‡	D	C	D	C	C	D*	B	B	B
London—												
Meteorological Office	B	—	C	C	B	B‡	B	D	D	D*	C	B
Embankment Gardens	A	B	B	B	—	B	D*	C	A‡	A	B	B
Golden Lane	B	B	B	B	B‡	B	B	B	D*	C	C	B
Malvern	A	A	B	B	A	A‡	A	B*	B*	A	A	A
Newcastle-upon-Tyne	B	B	C	B	B	B‡	B	C	B	C*	C	B
York	B	B	B	B	B	B‡	B	B	B	C*	B	B
Leith	B	B	B	B	A	A‡	B	C*	—	B	B	B
Paisley	C	B	A‡	B	C	B	B	D	D*	C	D	B

Summary	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
	2	7	2	0	1	8	2	0	1	9	2	0	0	10	1	1	2	7	2	0	2		0	1	2	7	1	2	0	6	4	2	1	4	2	4	2	3	6	1	1	5	5	1	2	10	0	0

Highest, 6·67, London, Meteorological Office, January.

Lowest, 0·20, Leith, September.

The asterisks also show that these volatile or combustible salts come down with the rain.

Soluble Matter: Ash.

	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.
Birmingham Central	—	C	C	C	B‡	B	C	C	D*	C	C	B
Exeter	B	B	A‡	B	B	B	A	B	D*	B	B	B
Kingston-upon-Hull	B‡	B	B	B	B	B	C*	B	C	B	C	B
Liverpool	B‡	C	B	C	C	B	B	B	B	B	C*	C
London—												
Meteorological Office	B	B	B	B‡	B	B	B	C	C*	C	C	B
Embankment Gardens	B	B‡	B	B	—	D*	D	B	D	D	D	B
Golden Lane	B	B	B‡	B	B	B	B	C	D*	C	C	B
Malvern	A	A	A	A	A	A‡	A	A	B*	A	A	A
Newcastle-upon-Tyne	B	B	B	B	B	B‡	B	C	D*	B	C	B
York	B	A	B	B	B	A‡	B	B	C*	B	B	B
Leith	A	A	A‡	B	B	A	B*	A	—	B	B	B
Paisley	B	B	A‡	B	B	B	B	C	D*	B	B	B

Summary	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
	2	9	0	0	3	7	2	0	4	7	1	0	1	9	2	0	1	9	1	0	3	8	0	1	2	7	2	1	2	5	5	0	0	2	3	6	1	7	3	1	1	4	6	1	1	10	1	0

Highest, 10·88, London, Embankment Gardens, September.

Lowest, 0·47, Leith, June.

The preponderance of D's in December is very striking.

Total Solids.

—	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.
Birmingham Central	—	D	C	C	B½	C	C	C	D*	D	C	C
Exeter	B	B	B	B	B½	B	B	B	B*	B	B	B
Kingston-upon-Hull	B	B	B	B	B	B	C*	B½	C	B	B	B
Liverpool	C	C	C	C*	C	C	C	C	C	C	B½	C
London—												
Meteorological Office	B	B½	B	B	B	B	B	C	C	C*	B	B
Embankment Gardens	C	C	C	B½	—	D*	C	C	C	C	D	C
Golden Lane	B½	B	B	B	B	B	B	C	C*	B	C	B
Malvern	A	A	A	A	A	A	A	A	A*	A	A	A½
Newcastle-upon-Tyne	C	B	C	B	B	B½	C	C	C*	C	C	B
York	B	B½	B	B	B	B	B	B	B*	B	B	B
Leith	B	B	B	B	B	A½	B*	B	—	B	B	B
Paisley	C	B	B	B	B	B	B½	C	C*	C	C	C
Summary	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D
	1 6 4 0	1 8 2 1	1 7 4 0	1 9 2 0	1 9 1 0	2 7 2 1	1 6 5 0	1 4 7 0	1 2 7 1	1 5 5 1	1 6 4 1	1 7 4 0

Highest, 34·29, Birmingham Central, December.

Lowest, 1·01 Malvern, March.

The effect of the November and December rainfall is very conspicuous in this table, but the rainfall of July has little apparent influence.

Sulphuric Acid.

—	April.	May.	June.	July	August.	September.	October.	November.	December.	January.	February.	March.
Birmingham Central	—	B	B	B	B½	B	B	C	D*	C	C	B
Exeter	A	A	A½	A	A	A	A	B	B*	B	B	B
Kingston-upon-Hull	B½	B	B	B	B	B	C*	B	C	B	B	B
Liverpool	B½	C	B	C	B	B	C	C	C*	C	B	B
London—												
Meteorological Office	B	B½	B	B	B	B	B	B	C*	C	B	B
Embankment Gardens	B	B	B	B½	—	B	C	B	C*	C	C	B
Golden Lane	B	B	B½	B	B	B	B	C	D*	C	C	B
Malvern	A	A	A	A	A	A½	A	A	A*	A	A	A
Newcastle-upon-Tyne	B½	B	B	B	B	B	B	C	C*	B	B	B
York	A½	A	B	B	B	A	B	B	B*	B	B	B
Leith	A	A	A	B	B	A½	B	B	—	A	B	B
Paisley	B	A	A½	B	B	A	B	B	C*	B	B	B
Summary	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D	A B C D
	4 7 0 0	5 6 1 0	4 8 0 0	2 9 1 0	2 9 0 0	5 7 0 0	2 7 3 0	1 7 4 0	1 2 6 2	2 5 5 0	1 8 3 0	1 11 0 0

Highest, 6·05, Golden Lane, December.

Lowest, 0·18, Malvern, September.

The effect of the December rainfall is again very marked.

Chlorine.

—	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.
Birmingham Central	—	D*	C	B	B	A‡	B	B	C	B	B	B
Exeter...	A	B	A‡	B	A	B	A	B	D*	C	C	A
Kingston-upon-Hull...	B	B	B	B	A‡	B	C*	B	C	B	B	B
Liverpool	B	B	B‡	C	B	C	B	C	D*	B	B	B
London—Meteorological Office	C	B	B	B	B	B	B	C	C*	C	B‡	B
Embankment Gardens ...	B	B‡	B	B	—	C	D	B	D	C	D*	B
Golden Lane...	B	B	B	B	B‡	B	B	B	C*	B	C	B
Malvern	A	A	A	B	A	A	A	B	B*	A	A	A‡
Newcastle-upon-Tyne	A	A	B	B	A‡	A‡	B	B	C*	B	B	B
York	B	B	B	B	A‡	B	B	B	C*	B	B	B
Leith	A	A	B	A	A	A‡	B	B	—	A	B	B*
Paisley	B	B	A‡	B	B	B	A-	C	D*	B	B	A
Summary ... A	4	3	3	1	6	4	3	0	0	2	1	3
B	6	8	8	10	5	6	7	9	1	7	8	9
C	1	0	1	1	0	2	1	3	1	3	2	0
D	0	1	0	0	0	0	1	0	6	0	1	0

Highest, 3·29, Paisley, December.
Lowest, 0·09, Leith, September.

The effect of the December rainfall is again conspicuous.

Ammonia.

—	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.
Birmingham Central	—	D	D*	C	B	B	B	B	B	A	B	A‡
Exeter	A	A‡	—	A‡	A	A‡	A	A	B*	A	B	A
Kingston-upon-Hull...	A	B	A‡	B	A	A	A	B	B*	B	B	A
Liverpool	B	C	C	D	C	C	C	C	C	D*	B	B‡
London—Meteorological Office	B	C*	B	B	A	B	A‡	B	B	B	—	A
Embankment Gardens ...	A	A‡	B	A	—	A	A	B	B*	B	B	B
Golden Lane...	B‡	C	B	C	B	B	B	C	C	B	C*	B
Malvern	A	A	A	B*	A	A‡	A	A	A	A	A	A
Newcastle-upon-Tyne	A‡	A‡	C	C	B	B	C	C	D*	B	C	C
York	D	B	C	D	D	C	D	D	D*	D	D	B‡
Leith	B	B	B	B	B	A‡	B	D*	—	C	B	B
Paisley	B	A‡	D*	B	B	B	B	B	C	B	B	B
Summary ... A	5	5	2	2	4	5	5	2	1	3	1	5
B	5	3	4	5	5	5	4	5	5	6	7	6
C	0	3	3	2	1	2	2	2	3	1	2	1
D	1	1	2	0	0	0	1	2	2	0	0	0

Highest, 2·58, Liverpool, January.
Lowest, 0·00, Malvern, September.

The effect of the December rainfall is less marked in this table.

There are many interesting points about the tables which it would be tedious to refer to in detail. We may arrive at some general conclusions by counting the whole number of A's, B's, C's, and D's for all the stations in the four seasons, spring (March–May), summer (June–August), autumn (September–November), and winter (December–February) respectively, and, combining on the one hand the A's and B's and on the other the C's and D's, we get the results shown in the table following

—	Tar.		Carbonaceous matter.		Insoluble ash.		Loss on ignition.		Soluble ash.		Total solids.		SO_3		Cl		NH_3	
	A&B	C&D	A&B	C&D	A&B	C&D	A&B	C&D	A&B	C&D	A&B	C&D	A&B	C&D	A&B	C&D	A&B	C&D
Spring ...	24	11	21	14	21	14	30	4	32	3	24	11	34	1	33	2	29	6
Summer ..	28	7	24	11	25	10	29	6	31	4	28	7	34	1	33	2	22	12
Autumn ...	28	8	23	13	27	9	26	10	27	9	21	15	29	7	29	7	26	10
Winter ...	22	13	22	13	25	10	16	19	15	20	16	19	19	16	19	16	23	11

A seasonal variation with a maximum in winter and a minimum in summer is clearly disclosed in the summary for total solids. There are 19 C's and D's in winter and only 7 in summer, and the same characteristic is emphasised in soluble ash and even more so in sulphuric acid; to less extent also in loss on ignition and also in tar.

Spring is the most productive of grit, summer and winter are equal in this respect, and autumn is least.

Carbonaceous matter other than tar (smuts and fragments of plants) shows no discrimination between the seasons; the slight preponderance of spring over summer may be regarded as fortuitous.

Ammonia is the only one which shows itself as a summer product; the number of C's and D's are twice as great in summer as in spring, and one and a half times as great as in autumn and winter.

The effect of the exceptionally wet month of December or July is a noticeable feature perhaps in tar, and certainly in the soluble compounds, loss on ignition, and soluble ash. It also appears quite clearly in total solids, and as it is not specially noteworthy in insoluble ash or smut the principal effect of the rain must be looked for in the dissolved constituents. The rain apparently takes out the dissolved constituents without much effect upon the insoluble ones. It may be that the effect which the rain would have in bringing down mineral dust is compensated by the absence of solid constituents of that nature in rainy weather, while the supply of dissolved or soluble constituents is undiminished.

The effect of the rainy month is clearly shown in the tables for sulphuric acid and chlorine, but less so with ammonia. How far the marked preponderance of the various products in winter is due to the fact that the particular winter under review was a rainy one is an open question.

APPENDIX I.—COMPARISON OF THE AMOUNTS OF RAIN COLLECTED IN THE SOOT GAUGES OF THE STATIONS OF TABLE I., WITH THE AMOUNTS RECORDED IN RAIN GAUGES OF THE NORMAL TYPE AT METEOROLOGICAL STATIONS IN THE IMMEDIATE VICINITY.

The results are given in millimetres and represent the difference between the results obtained from the soot gauge and the record of a normal rain gauge.

The sign + indicates that result obtained from the soot gauge is in excess; the − indicates that result obtained from the normal gauge is in excess.

—	April.	May.	June.	July	August.	September.	October.	November.	December.	January.	February.	March.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Birmingham ...	...	− 3	−17	+ 2	+ 1	− 2	− 2	− 7	+ 3	+ 1	− 5	+ 1
Bolton	...	...	...	−17	− 3	0	0	− 1	0	0	0	0
Exeter	− 7	+ 1	− 9	−11	+ 8	−14	−48	+12	+ 5	−11	+10	− 8
Kingston-upon-Hull	+ 1	− 1	+ 5	−19	− 5	− 3	0	− 5	−18	− 8	− 8	− 4
Liverpool† ...	+ 8	−18	−16	− 3	+24	+14	+ 9	+ 9	+15	+14	− 1	+13
London—Meteorological Office	+ 3	− 3	+ 1	+ 1	− 1	+ 1	+ 1	+ 6	−53	−16	− 7	− 1
Embankment Gardens ...	0	−17	0	− 4	...	+ 6	+ 1	− 4	−41	− 8	− 5	0
Golden Lane	+ 3	+ 9	− 4	− 1	+ 2	+ 2	+ 1	+ 6	−23	− 4	+ 1	+ 1
Malvern	− 5	− 4	− 4	−30	− 2	−12	− 3	−22	−71	−13	−32	− 4
Newcastle-upon-Tyne	− 2	− 8	+13	−30	−20	− 1	+ 7	+21	+14	− 7	− 1	+ 6
York	0	− 2	+ 1	−22	+ 6	− 1	− 6	+ 3	− 6	−10	− 2	+ 1
Leith	+ 4	−14	0	− 1	+ 2	− 1	+ 3	−10	...	− 5	− 2	− 2
Paisley	+ 6	+ 2	+ 2	−13	+10	− 1	− 5	−12	−11	− 3	− 4	+ 1

† The normal gauge is at the Liverpool Observatory at Bidston in Cheshire, not in Liverpool itself.

Note.—Differences of rainfall as recorded in neighbouring gauges may arise from various causes—as, for example, (1) difference of level above ground; (2) differences of site as regards freedom of exposure; (3) difference of the positions of the gauges in relation to eddies of wind. These causes might reasonably be held to account for the differences shown for Paisley, Leith, York, Kingston-upon-Hull, and Birmingham, but the differences indicated for individual months at Exeter, London (Meteorological Office), and Malvern cannot be accounted for without further inquiry. In the mode of procedure with the soot gauge accidental losses are possible, and it is noteworthy that the largest differences are in the direction of loss or omission.

APPENDIX II.—THE RATIO OF POLLUTION TO RAINFALL.

Table Showing the Amount of each Constituent of the Total Deposit for Six Months, October, 1914, to March, 1915, per 100 mm. of Rainfall.

Place.	Metric tons of deposit per square kilometre during month.								
	Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
	Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
Birmingham—									
Central	0·269	5·60	15·22	2·39	8 27	31 80	4·83	0·76	0·088
Aston	0·105	2·64	6·45	1·56	5·73	16·50	3·16	0·63	0·055
S.W.	0·050	0·92	2·38	0·75	3·09	7·18	1·38	0·51	0·028
Bolton	0·088	1·64	5·28	3·69	7·93	18·61	4·56	1·66	0·084
Exeter	0·043	1·75	3·22	1·95	4·29	11·28	1·95	0·97	0·038
Kingston-upon-Hull	0·116	3·92	7·08	4·05	7·85	23·02	4·56	1·13	0·093
Liverpool	0 382	3·06	11·14	4·20	6·03	24·80	4·42	1·32	0·760
London—									
Meteorological Office	0·227	1·30	6·85	6·12	7·77	22·30	4·13	1·43	0·089
Embankment Gardens	0·356	5·13	11·06	2·79	11·23	30·51	5·27	1·97	0·113
Finsbury Park	0·314	2·71	6·56	2·24	7·25	19·10	3·33	0·73	0·082
Ravenscourt Park	0·073	1·65	4·42	1·54	6·71	14·40	3·16	0·68	0 098
Southwark Park	0·120	4·37	8·39	2·12	8·85	23·85	4·52	0·93	0·118
Wandsworth Common	0·063	1·58	4·50	2·53	9·27	18·00	5·26	0·96	0·066
Victoria Park	0·073	1·93	4·15	2·52	8·10	16·78	4·58	0·81	0·071
Golden Lane	0·106	4·42	6·97	3·56	7·52	22·45	5·22	1·21	0·191
Malvern	0·006	0·25	0·47	1·19	1·95	3·88	1·03	0·55	0·025
Manchester—									
Ancoats Hospital	0·146	5·75	14·90	2·51	11·20	34·50	6·47	1·45	0·107
Bowdon	0·019	0·72	2·60	0·97	3·99	8·28	2·14	0·81	0·073
Cheadle	0·093	2·61	4·31	1·75	5·29	13·80	3·00	1·15	0·078
Davyhulme	0·028	1·49	5·79	1·37	7·27	16·00	4·10	1 08	0·125
Fallowfield	0·088	1·91	6·74	1·33	6·74	16·90	3·90	0·91	0·071
Moss-side	0·183	2·70	7·85	1·92	8·25	20·92	4·45	1·40	0·116
Philips Park	0·160	4·31	10·90	2·98	10·30	28·70	5·73	1·96	0·066
Queen's Park	0·103	2·51	9·92	1·67	9·61	23·81	5·45	1·48	0·058
School of Technology	0·155	4·30	8·68	1·80	7·31	22·25	4·23	1·40	0·097
University	0·151	3·50	7·94	1·79	6·77	20·22	3·69	1·45	0·105
Whitefield	0·041	1·68	6·20	1·67	7·95	17·52	4·47	1·43	0·474
Newcastle-upon-Tyne	0·211	6·06	9·90	3·49	7·80	27·50	4·14	1·08	0·322
Oldham	0·397	7·54	17·25	3·20	8·52	36·93	4·04	1·03	0·484
Sheffield—									
Attercliffe	0·249	6·00	12·89	2·92	9·78	31·82	4·35	2·72	0·142
Hillsborough Park	0·112	1·95	5·89	1·55	6·60	16·20	3·17	0·12	0·058
Meersbrook Park	0·115	1·84	4·72	1·78	6·23	14·70	3·09	1·25	0·060
Weston Park	0·128	1·98	5·08	2·28	6·32	15·80	3·45	1·17	0·052
York	0·172	2·51	5·58	2·57	5·52	16·58	3·23	1·11	0·726
Coatbridge	0·128	2·22	4·86	1·30	2·77	11·28	1·63	0·39	0·019
Greenock	0·053	1·66	2·97	1·59	3·21	8·90	1·80	0·67	0·133
Leith	0·162	3·54	9·59	4·54	6·90	24·72	3·74	1·26	0·435
Paisley	0·232	3·88	5·39	3·75	4·50	17·50	1·98	0 95	0·103
Stirling	0·228	1·93	2·02	2·20	2·78	9·16	1·82	0·65	0·106
Glasgow—									
Alexandra Park	0·099	6·96	7·40	11·20	17·87	43·51	13·55	1·01	0·487
Blythswood Square	0·030	8·30	6·27	6·72	10·76	32·10	6·91	0·52	0·426
Botanic Gardens	0·086	2·53	5·16	6·17	8·82	22·75	5·90	0·48	0·191
Bellahouston Park	—	1·84	3·78	4·93	4·50	15·05	2·94	0·66	0·298
Richmond Park	0·048	2·22	4·78	7·77	6·32	21·15	5·57	0·41	0·174
Ruchill Park	0·080	5·28	5·52	2·60	8·45	21·95	5·36	0 55	0·151
South Side Park	0·054	4·15	3·67	2·02	4·03	13·92	3·33	0·38	0·330
Tollcross Park	0·011	4·98	5·95	7·65	14·25	32·83	6·60	0·59	0·179
Victoria Park	0·057	5·15	3·26	8·52	7·91	24·88	6·65	0·53	0·516

Column 2 includes all matter insoluble in water but soluble in CS_2. Column 3 includes all combustible matter insoluble in water and in CS_2. Column 4 includes all earthy matter, fuel, ash, &c. One metric ton per square kilometre is equivalent to—(*a*) Approx. 9 lb. per acre; (*b*) 2·56 English tons per square mile; (*c*) one gramme per square metre.

The notes that have been added to previous tables indicate that the amount of deposit collected depends in some way, at present indistinct, upon the amount of rain which falls.

In order to examine this aspect of the question Dr. Owens has compiled a table of the amount of the various elements of the deposit which is associated with 100 mm. of rainfall during the six winter months. (See table on preceding page.)

It is evident from the table that there is no fixed ratio between the quantities, the ratios for different stations ranging over a scale of about 1 to 10 for most of the elements.

APPENDIX III.—MEASUREMENTS OF ATMOSPHERIC POLLUTION AT GLASGOW.

At the same meeting of the Committee at which the foregoing discussion of the results was presented, Mr. Bailie Smith handed in the results of the analysis obtained from nine gauges exposed in various parts of the City of Glasgow during the three months January, February, and March, 1915. The results are given in the following tables.

GLASGOW, ALEXANDRA PARK, BLYTHSWOOD SQUARE, AND BOTANIC GARDENS.

	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
Alexandra Park—										
January, 1915 ...	51	0·13	2·57	4·99	5·33	11·44	24·46	9·00	0·75	0·24
February ,, ...	89	0·03	7·24	3·65	10·55	10·74	32·21	8·50	0·55	0·33
March ,, ...	22	—	1·46	3·36	2·28	6·76	13·86	4·00	0·33	0·22
Total	162	0·16	11·27	12·00	18·16	28·94	70·53	21·50	1·63	0·79
Monthly mean	54	0·05	3·76	4·00	6·05	9·65	23·51	7·17	0·54	0·26
Blythswood Square—										
January, 1915 ...	59	0·01	3·34	5·31	4·52	8·78	21·96	5·58	0·55	0·42
February ,, ...	110	0·04	8·90	2·53	6·60	8·37	26·44	6·08	0·38	0·39
March ,, ...	33	0·01	4·55	4·83	2·46	4·60	16·45	2·28	0·12	0·05
Total	202	0·06	16·79	12·67	13·58	21·75	64·85	13·94	1·05	0·86
Monthly mean	67	0·02	5·60	4·22	4·53	7·25	21·62	4·65	0·35	0·29
Botanic Gardens—										
January, 1915 ...	62	0·16	1·88	2·34	3·73	6·20	14·31	4·29	0·43	0·09
February ,, ...	111	0·01	1·30	1·84	6·92	6·03	16·10	5·14	0·29	0·11
March ,, ...	26	—	1·85	6·06	1·63	5·30	14·84	2·29	0·21	0·18
Total	199	0·17	5·03	10·24	12·28	17·53	45·25	11·72	0·93	0·38
Monthly mean	66	0·06	1·68	3·41	4·09	5·84	15·08	3·91	0·31	0·13

GLASGOW, BELLAHOUSTON PARK, RICHMOND PARK, AND RUCHILL PARK.

Bellahouston Park—										
January 1915 ...	52	—	0·98	1·74	4·60	2·72	10·04	1·83	0·56	0·03
February ,, ...	75	—	0·56	1·03	2·40	1·81	5·80	1·81	0·30	0·37
March ,, ...	21	—	1·18	2·81	0·30	2·13	6·42	0·72	0·12	0·04
Total	148	—	2·72	5·58	7·30	6·66	22·26	4·36	0·98	0·44
Monthly mean	49	—	0·91	1·86	2·43	2·22	7·42	1·45	0·33	0·15
Richmond Park—										
January 1915 ...	69	0·06	2·17	3·75	5·25	6·90	18·13	4·42	0·33	0·16
February ,, ...	114	0·04	0·80	1·14	8·57	2·57	13·12	5·07	0·36	0·11
March ,, ...	24	—	1·63	5·00	2·27	3·61	12·51	2·05	0·15	0·09
Total	207	0·10	4·60	9·89	16·09	13·08	43·76	11·54	0·84	0·36
Monthly mean	69	0·03	1·53	3·30	5·36	4·36	14·59	3·85	0·28	0·12
Ruchill Park—										
January, 1915 ...	65	0·11	2·21	5·23	2·22	6·24	16·01	4·58	0·43	0·14
February ,, ...	113	0·03	7·27	1·67	2·94	5·44	17·35	4·20	0·45	0·11
March ,, ...	34	0·03	1·72	4·80	0·35	6·18	13·08	2·58	0·29	0·07
Total	212	0·17	11·20	11·70	5·51	17·86	46·44	11·36	1·17	0·32
Monthly mean	71	0·06	3·73	3·90	1·84	5·95	15·48	3·79	0·39	0·11

GLASGOW, SOUTH SIDE PARK, TOLLCROSS PARK, AND VICTORIA PARK.

	Rainfall in millimetres.	Metric tons per square kilometre.								
		Insoluble matter.			Soluble matter.		Total solids.	Included in soluble matter.		
		Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.		Sulphate as (SO_4).	Chlorine (Cl).	Ammonia (NH_3).
South Side Park—										
January, 1915 ...	55	0·07	0·78	1·48	0·66	2·34	5·33	2·19	0·31	0·07
February ,, ...	106	—	5·63	1·76	2·13	2·13	11·65	2·88	0·28	0·16
March ,, ...	24	0·03	1·26	3·54	0·95	2·99	8·77	1·10	0·11	0·38
Total	185	0·10	7·67	6·78	3·74	7·46	25·75	6·17	0·70	0·61
Monthly mean	62	0·03	2·56	2·26	1·25	2·49	8·58	2·06	0·23	0·20
Tollcross Park—										
January, 1915 ...	53	—	1·61	2·90	4·96	8·21	17·68	6·02	0·53	0·16
February ,, ...	108	—	6·31	2·66	6·94	12·57	28·48	5·87	0·36	0·08
March ,, ...	24	0·02	1·31	5·44	2·25	5·56	14·58	0·32	0·21	0·09
Total	185	0·02	9·23	11·00	14·15	26·34	60·74	12·21	1·10	0·33
Monthly mean	62	0·01	3·08	3·67	4·72	8·78	20·25	4·07	0·37	0·11
Victoria Park—										
January, 1915 ...	66	0·10	1·36	2·39	7·28	6·18	17·31	5·76	0·56	0·39
February ,, ...	112	—	8·23	1·55	8·32	6·27	24·37	5·96	0·41	0·49
March ,, ...	35	0·02	1·37	3·00	2·54	4·37	11·30	2·45	0·15	0·22
Total	213	0·12	10·96	6·94	18·14	16·82	52·98	14·17	1·12	1·10
Monthly mean	71	0·04	3·65	2·31	6·05	5·61	17·66	4·72	0·37	0·37

Analysing these in the same manner as the tables for six months given on page xxix. we get the following results:—

Stations.	Number of months.	Rainfall mean mm.	Insoluble.			Soluble.						Summary
			Units in tons per K^2 per month.									
			Tar.	Carbonaceous other than tar.	Ash.	Loss on ignition.	Ash.	Total solids.	Sulphuric acid.	Chloriae.	Ammonia.	
			0·05	1	2	0·75	1·5	5	1	0·3	0·05	A B C D
Glasgow, Alexandra Park	3	54	B†	C	B	D*	D*	C*	D*	B*	D	0 3 2 4
,, Bellahouston Park	3	49	—	A*	A*	C	B*	B*	B*	B	C	2 4 2 0
,, Blythswood Square	3	67	A†	D*	B*	D	C	C	C	B	D*	1 2 3 3
,, Botanic Gardens	3	66	B*	B	B	D	C	C	C	B	B	0 5 3 1
,, Richmond Park	3	69	A	B	B	D	B	B	C	A	B	2 5 1 1
,, Ruchill Park	3	71	B*	C	B	B	C	C	C	B	B*	0 5 4 0
,, South Side Park	3	62	A	B	B	B*	B	B	B	A*	C	2 6 1 0
,, Tollcross Park	3	62	A*	C	B	D	D	C	C	B	B*	1 3 3 2
,, Victoria Park	3	71	A	C	B	D*	C	C	C	B	D	1 2 4 2

The summary of results for the set of nine stations is as follows:—

		A	B	C	D
Insoluble	Tar	5	3	0	0
	Carbonaceous matter other than tar	1	3	4	1
	Ash	1	8	0	0
Soluble...	Loss on ignition	0	2	1	6
	Ash	0	3	4	2

	A	B	C	D
Total Solids	0	3	6	0
Sulphuric Acid (SO_4)	0	2	6	1
Chlorine (Cl)	2	7	0	0
Ammonia (NH_3)	0	4	2	3